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Japan Report

(FOUO 42/81)

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JAPAN REPORT

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ECONOMIC

GOVERNMENT DRAFTS OIL MONEY RECYCLING CONCEPT

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 960, 23 Jun 81 pp 1,3

[Text]

The Government has worked out an "oil money recycling concept" of its own for helping the non oil-developing nations extricate themselves from the difficulty not being able readily to procure money because of their growing external liabilities.

The concept envisions use of Japan's Overseas Economic Cooperation Fund (OECF) and other means to help these nations secure oil money from members of the Organization of Petroleum Exporting Countries (OPEC) or from the financial markets of the industrially-advanced nations

Its salient points include, according to the Ministry of International Trade & Industry, such points as: 1) OECF will guarantee the liabilities shouldered by the developing nations in making borrowings; 2) Funds of OECF will be used for lightening the interest burden of the developing nations.

Prospects are, however, that it will take some time before such a plan will be realized since the Ministry of Finance, which lacks fiscal revenue, is taking a passive view toward it.

The external liabilities of the non oil-producing developing countries yearly have been swelling from the worsening of their current payments account with the elevation of crude oil prices.

At the end of 1980, their outstanding external liabilities reached about $320 billion, or nearly treble that for around 1975. This has meant a further lowering of their credit standing, making it more difficult for them to procure money.

The Government feels that if this situation is left as it is, the economic growth of the developing nations is going to come to a halt, which, in turn, poses danger of trade between the advanced and developing nations narrowing.

This led it to draw up a concept for using OECF funds for helping recycle oil money. Using OECF money to guarantee the liability position of the developing nations, it is held, can serve to lessen the default fears of the OPEC and advanced nations as to lending their money and ease their lending terms.

The OECF money also can be used for guaranteeing liabilities in the event the developing nations seek money also from Japanese city banks.

The Japanese banks now also have a large amount of oil money from the oil-producing countries' investment in Japan. The concept thus anticipates recycling such money to the non oil-producing nations.

Offering interest supplementation and liability guarantee can have the effect of inducing the money lenders to ease their loan terms, such as interest rate and redemption period, it is felt.

The Government considers that this new concept of recycling oil money can become a new way of economic aid to the developing nations. It wishes to center the benefits of this recycling concept on industrial projects, such as pertaining to chemical and steel plants, whereas yen loan cooperation up to this time has been granted principally to improvement of social capital, such as bettering of ports and highways.

The thinking is that if industrial projects are promoted, it will serve to increase the foreign exchange earnings of the developing nations in a relatively short time, and this will contribute also to redemption of their liabilities.

CSO: 4120/266

ECONOMIC

AUTO EXPORT QUOTA ANGERS SMALL CARMAKERS

Tokyo DAILY YOMIURI in English 30 Jun 81 p 5

[Text] Competition among domestic carmakers has become more intense as car exports to the main market of the US and Western Europe have come to be controlled.

Toyota Motor and Nissan Motor companies, the big two carmakers of Japan are complaining about the recently decided export quota by saying that it is not a fair allocation, while Isuzu Motors, a minor automaker, is complaining that this kind of quota is certain to make local sales companies suffer from large deficits.

The main reason for their complaints against the complicated export quota comes from the fact that Toyota and Nissan claimed a proportional allocation in accordance with their past export performance while Honda Motor and Mitsubishi Motor companies and other automakers insisted on a special consideration in view of circumstances facing the small carmakers.

When the quota to the US market was decided at 1,680,000, Nissan Motor Company President Takashi Ishihara, who is also president of the Japan Automobile Manufacturers Association, said that it was reasonable to decide on each automaker's quota in accordance with the individual export performance during 1979 and 1980 as the figure 1,680,000 was reached by reviewing the exports during the two years.

It is advantageous for large carmakers when quota is decided in accordance with past shares. Naturally Toyota sided with Ishihara.

Masaya Hanai, board chairman of Toyota, says, "Self-restraints on car exports to the US go against free trade. Therefore, I in principle object to allocation of quota to individual makers. But as long as Japan and the US has reached an agreement, we have to stick to the figure.

"With the situation as it is there is no other alternative but to decide on the individual quota in accordance with past performance."

Small automakers, however, squarely argue with the big carmakers about their insistence.

They claim that the big two went out of their way to increase their exports to the US in anticipation of the inevitable self-restraints.

In this sense, they insist, the sudden car export rush by the big two was their strategy aimed at jockeying for position.

Executives of Honda, the third largest automaker, angrily say that they cannot accept the allocation method because it will benefit only those companies which forestalled others.

Honda has shown a positive attitude toward investing in the US. Citing this fact, Honda insists that it is unfair to neglect its investment in the US and purchase of parts from US makers.

The situation of Mitsubishi, Toyo Kogyo and Isuzu, which have entered into tie-ups with US automakers, is more complicated.

Mitsubishi, which has entered into a capital tie-up with Chrysler, is suffering from a gradual decrease in shipment of its products along with its US partner's deteriorating business performance.

Mitsubishi is unhappy with the latest decision on quota because it has just started forming its own sales network in the US at the request of Chrysler.

Isuzu also has its own reason. It stopped exports to the US in the middle of 1979 and resumed only this year. In this situation its exports to the US will be hard hit if the quota is implemented in accordance with past two-year performance.

Criticizing egoism of the big two, Isuzu President Toshio Okamoto says that the problem is not of individual quota but of the attitude of Toyota and Nissan which once questioned why Japan was forced to curb car exports to the US.

It is therefore very difficult to unify opinion within the Japanese auto industry. The individual quota problem seems to be increasing confrontation among carmakers.

PHOTO CAPTION

1. p 5. ANGLO-AMERICAN SUPERBATTERY—Under terms of a recent agreement, General Electric Co of the US and Chloride Silent Power of Britain are jointly developing a superbattery for electric vehicle propulsion. Making use of sodium and sulfur reactants and a "betta-alumina" ceramic electrolyte, the new battery promises to outperform and outlast conventional lead/acid batteries by a wide margin. Electrochemistry specialists are seen here preparing a laboratory-size sodium/sulfur cell for tests at General Electric's advanced battery development facility in Schenectady, New York. — Fujifotos.

CSO: 4120/270

ECONOMIC

CAR EXPORTS FACE 60 PERCENT IMPORT CONTROL PROSPECT

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 960, 23 Jun 81 pp 1,4

[Article by Fumio Tateiwa]

[Text] The Japan-EC auto dispute hit a temporary lull amid a sulky and grim atmosphere when Japan announced last week it would voluntarily limit this year's car exports to Belgium to 7 per cent less than last year.

This meant that if other voluntary restraints and import restrictions were included, almost 60 per cent of Japan's total car exports would be under some form of control this year, casting ominous clouds over Japanese automakers, observers said.

When the Japan-Belgium car export issue surfaced last fall, the Government took an optimistic view that the issue would be settled if this year's car exports to Belgium grew "at a moderate rate." But last January the Government was forced to declare that, citing a specific figure, its car exports to Benelux would grow by "10 per cent over last year." Then at a meeting with Belgian Economics Minister Willy Claes, Minister of International Trade & Industry Rokusuke Tanaka announced last week that Japan would limit this year's car exports to Belgium to "7 per cent less than last year's level," accepting Belgian requests.

The Belgian Government has been complaining since last fall of Japanese surging car exports as it was hit hard by a recession and protectionist sentiments in France and Italy. It appealed to Japan that if things go unchecked, it would have no other choice but to resort to import controls of Japanese cars this year.

Japan's car exports to Belgium account for only 2.6 per cent of its total car exports — not a high percentage. But it is feared that if Belgium turns protectionist, the whole European Community might follow suit. Confronted with this prospect, the Japanese Government decided to restrain its car exports to Belgium. The Government took the stance that the bulwark of free trade must not be lost over immediate gains. The decision followed one to limit this year's growth of car exports to West Germany to 10 per cent over last year.

The EC will hold its foreign ministers' meeting this week to discuss trade friction with Japan. Opinions among members of the EC Commission have been to strongly demand that the EEC as a whole should restrict Japanese car imports.

Officials of the Japanese Ministry of International Trade & Industry believe that Belgium and West Germany, to which Japan's car exports are limited this year, will be opposed to EC-wide restrictions.

MITI officials also believe that the issue of Japanese exports will not be included on the agenda of the summit talks of the seven industrialized nations in Ottawa in July, despite the demand in some circles in the EC that it should be.

The sole purpose of Japanese decision to limit its car exports is to stop further deterioration of the situation — especially, to prevent introduction of protectionist legislation in the U.S. Congress, activation of safeguard clauses by the EC and repercussion on other products.

Meanwhile, the Japanese have been successful in having proposal accepted to some extent. The U.S. wanted to cut down Japanese exports to 1.48 million vehicles this year, which ended up, however, at 1.68 million after Japanese objections. West Germany wanted to limit Japan's car exports to the same level as last year, but it ended up with 10 per cent growth for Japan. The same thing is true with Belgium, which demanded 10 per cent reduction over last year, but the result ended up 7 per cent cutdown.

On the surface, MITI's attempts to stop further deterioration of the matter seemed to be working. At least, for the time being, criticisms against Japan's surging car exports will subside in the U.S., Canada, West Germany and Benelux.

But, observers said, this is only a temporary lull and cannot guarantee that protectionist sentiments against Japanese cars will never rise again in those countries. Especially, observers said, criticisms might flare up again in the EC which is hit hard by economic recession. MITI officials even expressed apprehension that things might start all over again in the EC this fall.

Officials also feared that there might be some repercussion on Japan's machine tool exports to the EC. Prime Minister Zenko Suzuki said, in a meeting with EC Chairman of Commission Gaston Thorn last week, that Japan will avoid "torrent-like" exports to the EC and uphold free trade principles. But Suzuki's statement is generalized and not specific. If individual items are discussed, there can be criticisms flaring up again against Japan.

Then the question is what these measures will do to Japanese car exports. MITI believes that Japan's car exports to the advanced countries will grow by 10 per cent a year at the maximum. The expression formerly used, "moderate growth", has been changed to specifically "less than 10 per cent growth" in its recent deals with Canada and West Germany. Sweden is also in a mood to limit Japan's car exports. Recent events seemed to cast very gloomy and ominous clouds over Japanese car exports in the coming years.

CSO: 4120/266

SCIENCE AND TECHNOLOGY JAPAN

WORLD ECONOMY AND TECHNOLOGICAL INNOVATION OVERVIEWED

Tokyo DAILY YOMIURI in English 22, 23, 24, 25, 26 Jun 81

/22 Jun 81, p 5/

[Text] **The following is a position paper presented by Seikei University Professor Miyohei Shinohara, who was moderator at a recent symposium held in Tokyo under the general theme "The Stagnating World Economy and Technological Innovation."**

Excerpts from the comments of the participants will be carried on page 5 on subsequent days.

The symposium was organized by Tokyo Colloquium and sponsored by The Yomiuri Shimbun.

Until the mid-1970s, the world economy achieved a rapid rate of growth unprecedented before World War II; it was made possible by low cost and unlimited supplies of oil, a broad spectrum of technological innovation that advanced during the war and blossomed in its wake, and the Keynesian type of aggregate demand management.

In addition, the expansion of multinational corporations overseas and the accompanying export of technology brought the wave of economic growth generated by the advanced nations to the shores of the less developed countries (LDCs), producing many semideveloped nations known as "newly industrializing countries" (NICs).

However, with the first oil crisis in 1973, the limitations of energy resources became manifest, and even before that, with 1970 as the turning point, the tempo of world technological development slowed.

Almost all of the innovations that appeared in rapid sucession in the postwar period—television, radar, antibiotics, jet aircraft, synthetic rubber, DDT, electronics, nuclear power, and the continuous casting method in steel—led to the development of a wide variety of new products from virtually every industry, thereby contributing much to accelerated growth in the world economy.

After 1970 technological advances in many industries slackened, and the appearance of new products was far less frequent than during the age of rapid economic growth.

The development of new types of technology in the coming decades of this century is now the focus of considerable attention and anticipation.

They include: 1) the widespread dissemination of telecommunications technology as predicted by Norman Macrae (for example, the microcomputer revolution); 2) the advance of "mechatronics" combining the features of mechanics and electronics; 3) the further development of energy and resource conservation made possible by a revolution in materials such as fine ceramics, high-function, high-molecular materials, and super alloys; 4) production of new medicines such as interferon and their cost reduction, as well as improved and increased crops for farm products, using biotechnology and gene-recombination technology; 5) macroengineering; and 6) development of new energy sources.

The potential for steady development in these new technologies is undeniable, but whether, by the end of this century, they will provide sufficient impetus to break through the stagnation that has gripped the world economy since 1970 and create a new, long-term upswing, remains to be seen.

As Joseph Schumpeter pointed out, the prolonged downward trend in economy can be seen as the "gestation period" of new technologies.

It also seems possible that a continuous hikes in oil prices by oil-producing countries may restrain the tempo of world growth and that this slow growth in turn may deter the potential for technological innovation. In any case, it is unknown to what degree the new technologies will be able to boost the world economy.

Let us suppose that oil-producing countries progressively increase the price of oil relative to other manufacturing commodities. This would mean that the balance of payments for the oil-producing nations, particularly nonoil-producing LDCs, unfavorable. If the recycling of oil money from surplus nations to deficit countries fails to operate, forcing slow growth in the latter, then the potential for technological innovation in the world economy will be commensurately restrained.

If, however, the increase in relative oil prices sufficiently stimulates energy conservation efforts and advances in energy-saving technology, oil supply would surpass demand, creating the possibility of halting midway the upward curve in relative oil prices. Such a possibility depends on the extent to which all industries can turn toward oil-saving and energy-conserving technology. The shift from high energy consuming automobiles to economy models will not be enough.

The world economy in the remaining years of this century, in addition to more intense friction between advanced nations and arise in protectionism, will probably suffer from growing conflict between oil-producing and nonoil-producing countries and widening gap in income between the two. This may further divide the Third World into the NICs, semi-NIC's, LDCs and LLDCs (least less-developed countries). Latent in this development is a dynamism in which Southeast Asian LDCs will catch up with the present East Asian NICs levels, successfully becoming semi-NICs or NICs themselves.

Of course, industrialization of NICs may intensify a dual structure domestically, while internationally it may result in the concentration of the "most seriously affected countries" in Africa and South Asia.

For these reasons, the two decades leading to the year 2000 can be described as a period of tension between stagnation in the world economy as a result of pressures applied by oil-producing countries on the one hand, and dynamism that may overcome such stagnation, fostering new technological innovation after 1990 or 2000, on the other.

What kind of multipolarization this process will bring about, in the context of the world economy and in relations among advanced countries, between advanced nations, NICs and LDCs, and between oil-producing and nonoil-producing countries is a topic that merits careful research and discussion.

(To be continued)

/23 Jun 81, p 5/

This is the second of five instalments of a recent symposium, organized by Tokyo Colloquium and sponsored by The Yomiuri Shimbun, which was held in Tokyo under the theme "The Stagnating World Economy and Technological Innovation."

Participants were Jacques Lesourne, professor at Le Conservatoire National des Arts et Metiers in Paris, Norman Macrae, deputy editor of The Economist, London, Toshio Sanuki, deputy director-general, Research Institute of Capital Formation, Japan Development Bank, Takeo Takahashi, director-general, Economic Research Institute, Economic Planning Agency, and Miyohei Shinohara, professor at Seikei University who acted as moderator.

Moderator: The first topic is the "Technological Innovation in Retrospect and the Prospect for the Coming Two Decades."

Macrae: I think economic growth depends on (a) the advance of technological know-how and (b) the existence of some leading country or countries with a dynamic enough business system to put that advancing technology into productive effect with a daily hunt for higher productivity tomorrow.

So, apart from some appalling macro-economic error bringing about a slump on the 1929 scale—possibilities of which I think have increased but I wouldn't expect any slump to last long—any slowdown must be caused either (a) by the advance of technological know-how slowing down or (b) pace-setting countries growing tired of the ethics of glorification of businessmen which is necessary for creating economic growth.

On the first point, the slowdown of the advance of technological know-how, I am a born optimist.

Technological innovation is relatively recent. It started with an explosion in 1770s and it has been exploding ever since. In every decade since the 1770s man has increased his power in some way over energy or matter. And in the past two and a half decades we have had a breakthrough in the processing of information.

Additionally, the whole two hundred years of growth of technological know-how has been irrigated by three big transport revolutions. First, the steam-engine, with railways connected to it. Then the petro-engine, with the automobile connected to it. The big, third transport revolution has been that of telecommunications attached to computers. Each of these has had far huger effects than anybody dreamed about at the beginning. Each of them has totally changed society.

I think that the advance of telecommunications and computer technology, generally, means that brain workers will no longer be tied to a place of work. People will work from places they would like to work from. It could ultimately mean the end of the nation-state. So, on the possibility of a slowdown in the advance of technological know-how, I don't believe there is any need for concern.

I am much more worried about point (b), about whether pace-setting countries are going to get tired of growth. This is to me the worrisome point ahead—the political one rather than the technological one.

Role Of 'Trigger' Industries

Sanuki: When we consider past economic growth in a very long perspective, I think we always have to consider what has been behind it. And that, from the beginning, has been technical innovation.

Right after World War II there was a dramatic surge in technological innovation based on military technology advancements. It was through wartime military technology being transferred to and utilized by the private sector that, for the first time, we were able to see really dramatic economic growth throughout many parts of the world, including Asia and Europe. With technological application in the private sector of such items as nylon and radar, as well as of production technology in other areas, the world at large saw a tremendous surge in economic growth.

Now, the post-World War II advance in technological innovation required the utilization of huge amounts of capital and equipment investment. Taking Japan as an example, we see that economic growth here was made possible by three groups of "trigger industries."

By "trigger industries" I mean those industries which had the capacity for initiating their own really explosive growth and, at the same time, were able to take the initiative in maintaining continuous industrial growth. First, there was the thermal-power generation industry. The second group was made up of oil refineries, petrochemicals, iron and steel, and shipbuilding. The third group comprised the automobile and home-appliance industries.

These three groups of trigger industries were fully able to utilize the merits of scale, to go into mass production in special ways.

In addition to the effects produced by being able to utilize the merits of scale, there was a contradictory demand for quality control. The technological innovations that were introduced to meet this demand resulted in improved quality, which in turn led to further expansion of these industries. Thus, the mutual stimulation provided by technology and the merits of scale in these industries served to very good effect in bringing growth to the economy as a whole.

The fact of being able to materialize and realize such merits of scale in the economy created a type of cycle wherein technological innovation led to additional capital investment, additional capital investment led to further technological innovation, further technological innovation led to even greater capital investment, and so on. Through this cyclic process the world economy, and especially the Japanese economy, was able to enjoy a high growth up until the 1960s.

Japanese Economy

When you take Japanese economic growth as an example, however, you then come eventually to reach the period where Japan comes face to face with five big walls, or obstacles.

The first wall has been the environmental and pollution issue, which encompasses not only industrial pollution but various problems arising from social investment, such as those created by the super-express "bullet" trains, roads and airports, as well as the expanding requirements for the disposal of waste materials.

The second wall Japan faces is her lack of natural resources and energy supplies. The third is her need to adjust relations with other countries in the area of trade imbalances, security and other multifarious problems. The fourth wall is the limits on mass production. Japan has now reached the point where improvements in mass-production techniques no longer lead to declines in cost. Japan's fifth and final wall is the problem of making further technological innovations.

If we are to find some way to break through these walls, I think we need to look closely at means of increasing productivity in six different areas.

Those areas are (1) capital investment, (2) labor, (3) energy, (4) materials, (5) space, and (6) investments in environments and in pollution abatement.

Only by realizing a well-balanced productivity increase in all six of these areas can Japan, as well as the rest of the world, realize strong continued growth. I believe that this is the task we all face as we look toward the 21st century.

And lastly, I would like to mention the kinds of industry that I believe can take the lead in further economic growth during the 20 years leading up to the 21st century. They, for example, are: 1) electronics, 2) mechatronics, 3) new raw materials, 4) ultra-advanced technologies, 5) macro-engineering, 6) life and genetic sciences, and 7) the new energy sources.

The world led by the US and Japan has entered upon the "electronics revolution." With electronic technology as the backbone of industrial growth, the utilization of these seven industries to the utmost can and will, I believe, lead an era of further growth.

Stability Of Intl Framework

Lesourne: I just would like to consider two points.

The first one is the role of technological innovation in postwar growth and the second is about the prospects of technical innovation over the next two decades.

First, I would agree with Professor Shinohara's remark that postwar growth has been made possible by low-cost energy, technological innovation and Keynesian demand management. (See the moderator's note in the first installment of this series.) But I think that we should maybe add some more basic factors and I would like to mention three of them.

The first one is the stability of the international framework that has been established since the war by dint of the regulatory power of the US on the military, political and economic levels.

The second is the flexibility of social structures in many presently advancing industrial societies. And I speak essentially of those countries which have seen social transformation as a result of World War II.

The third one is a certain attitude toward growth, which I think is an important psychological factor in the behavior not only of managers but also of most of the social groups in Japanese and European and American society.

I think that these factors have made easier the putting of technological innovation into practice, since it is important—and I think this is a point on which all of us will easily agree--to separate the possibilities of technology resulting from science and technique on the one hand, and the effective use of these possibilities in business as a consequence of investment on the other.

Of course, during the postwar growth period the situations in various developed countries with respect to technological innovation have been different.

At the beginning of the period, Western Europe and Japan imported directly or indirectly many technological innovations from the US. Even when they did not import them, they knew that such innovations existed, which was of course a tremendous help. For instance, France did not get any information on gaseous diffusion in atomic energy, but we knew that a gaseous diffusion plant had been built, and that was very important.

And, of course, throughout the period the technological gap between the US and the other industrial societies has progressively decreased. Consequently these societies have had to take on a more important share of the responsibility for technological innovation.

Now, on the second point, I, like Mr Macrae, am an optimist, and I think that presently some very important technological "adventures" are taking place.

The first one, of course, is what I have called the "electronic complex," which of course includes electronics, mechatronics, and the use of computers, but more generally encompasses the introduction of electronics into industrial life, office life, and capital goods. And as the preceding speakers have said, I think that the economic structures of our societies are becoming progressively reorganized around these major facts.

But we see also the beginning of a second major adventure, or transformation, which probably will reach its peak at the end of the century, and that is the introduction of biological knowledge into economic life.

And there are other such technological adventures as the development of new energy sources and new materials, and the conquest of the oceans. But of the main two, I think, I would put electronics first in importance and biology next.

Thus the problem may be less in technological innovation as such than in the possibilities of rapid implementation of technological innovation, which will be determined by the world situation and international political and economic system as well as by social attitudes within the advanced industrial societies.

We must of course take into account the fact that the new technological adventures which I have described are themselves creating the possibility of economic structures which will be very different from the economic structures of the past.

For instance, electronics is progressively breaking down the division that economists have traditionally assumed between the industrial and service sectors.

Electronics may also, with the development of the new kinds of services, decrease the meaning of GNP as a yardstick. So it is quite possible that many of our concepts about the industrial structure of an economy may have to be progressively revised and adapted to a type of economy in which the importance of electronics will be much more prominent.

Kondratieff Cycle Hypothesis

Takahashi: Taking into consideration the viewpoints held in common by Mr Macrae and Mr Lesourne, I would like to center my comments on three points: 1) the Kondratieff cycle hypothesis, 2) changes in the characteristics of technological innovation, which is a very important factor in that cycle, and 3) the outlook for technological innovation during the final decades of the 20th century.

As regards No 1, the Kondratieff cycle hypothesis, Kondratieff stated that since the Industrial Revolution economic fluctuations have moved in long wave cycles. Since then many people have described many elements as factors contributing to such economic fluctuations.

However, the two major factors responsible for such fluctuations are (1) the accumulation of technological know-how and (2) how that accumulated know-how is combined in the field of science and those combinations are utilized in the actual world of business.

Kondratieff noticed three upswing-downswing cycles between 1790 and 1920, and there the Kondratieff cycle stops. However, W. W. Rostow has tried to trace them further, and, according to him, right now we are in the fifth upswing cycle which started in 1972. This is the era of stagflation which we find ourselves in at present. The question is how long this situation will continue.

As regards the second point, changes in the characteristics of technological innovation, the most critical fact here is that today transfers of technology have become very difficult. That is due to the fact that the most of today's technological innovation is taking place in such field as military science and space science. By contrast, before the war it was in the private sector that most innovation took place, and technology could therefore be introduced directly into the production process at the plant level.

As regards my third and final point, the outlook for the future technological innovation, I would like to just say that today we are in a transitional phase which will lead to another period of increasing long-term technological innovation.

To be continued

/24 Jun 81, p 5/

This is the third of five instalments of a recent symposium, organized by Tokyo Colloquium and sponsored by The Yomiuri Shimbun, which was held in Tokyo under the theme "The Stagnating World Economy and Technological Innovation."

Participants were Jacques Lesourne, professor at Le Conservatoire National des Arts et Metiers in Paris, Norman Macrae, deputy editor of The Economist, London, Toshio Sanuki, deputy director-general, Research Institute of Capital Formation, Japan Development Bank, Takeo Takahashi, director-general, Economic Research Institute, Economic Planning Agency, and Miyohei Shinohara, professor at Seikei University who acted as moderator.

Moderator: There seems to be two potential problems we should direct our attention to. One has to do with whether or not worldwide technological innovation stagnates during the period shortly before and after we hit the resource and energy ceiling.

The second, should technological innovation develop very actively after hitting the resource and energy ceiling, will increasing hikes in prices of oil and other primary commodities serve to suppress technological innovation in spite of its very strong potential.

Macrae: It seems that we here fairly well agree with each other. The main point of disagreement that has arisen seems to be not among ourselves but with outside people, namely Kondratieff and Walt Rostow. And I have an inevitable inclination to put in my own arguments with Walt Rostow.

You can also explain the very long-term economics from 1780 onward in terms of the pace-setting countries. From 1780 to 1870 the pace-setting country was strangely Britain. The by no doubt bogus figures suggest that during that period Britain's GNP per person employed was increasing at about 1.2 percent per year. That seems small to us now, but nobody else was increasing by more than around one percent over the period. And this slow 0.2 or 0.3 percent gap compounded over a hundred years brought Britain up from a small island to where it was able to create the British Empire by mistake.

The cycles in the Kondratieff cycle were very much internal British cycles, which then became pushed onward to the rest of the world by a normal lag effect.

Free Trade Policy

British economic dynamism in that period was largely based on a policy of politicians' keeping out of businessmen's way. It was called free trade and this was the period when businessmen were respectable.

During the whole period between 1780 and 1870 there wasn't a single British politician whose name most people can remember now. By 1870, however, politics were getting more important. Pressures were being put upon the businessmen by politicians, imperial policy was being created, and Kondratieff's slowdown from 1873 onwards was the period when Britain's rate of productivity increase — though not productivity itself—had stopped rising.

Very fortunately for the world, just about that period when Britain was slowing down as the pace-setter, the US took over. And from 1870 to 1950 on the same, possibly bogus statistics, America's GNP per person employed increased by an annual average of 1.8 percent.

The next highest group, between 1 percent and 1.2 percent, was made up of a large chunk of countries, still including Britain at its old rate, but now also including Germany and Japan and some other countries, though not yet France. And this 0.6 percent growth gap in favor of the US, compounded over 80 years, brought America up from a hick slave trader in the 1860s to a political and economic leader of the world.

During this period of dynamism, American policy was that politicians kept out of businessmen's way. Businessmen were the respectable people in the society. And from 1870 until Roosevelt, it is very, very difficult for anybody to remember the name of a single American president. Politicians were unimportant. By the end of the period politics were again becoming important.

Government expenditure, that portion of GNP in America, went up from 9 percent in 1931 to nearly 30 percent even before the war started. And since 1950 onwards, American productivity—again by GNP per person employed—has remained stuck at about 1.8 percent a year.

But what has happened in this period is that new pace-setters have taken over. If you use the figures in the same order as I have been using them, from 1950 to 1980 Japan's figures were about 6.7 percent per year and Germany's 4.5 percent a year. While Japan and Germany have slowed recently, France's figures have risen above those of Germany during the last five or six years.

Again I argue of course that this period of dynamism came about because politicians were unimportant in Japan and Germany in the period after 1945. France, for 23 years till recently, more or less gave up politics and had a constitutional monarch under another name. And businessmen were respectable.

There is a very great danger, I think now, of excessive environmentalism, excessive regulation of the type which has crept into the US from 1950 onwards, and which is now creeping into the other dynamic pace-setting countries. This is what I see as the danger ahead.

Change In Energy Situation

Lesourne: Of course, we all agree that the Kondratieff cycle is a statistical fact—at least if we measure it using rates of growth. Sometimes I tell myself that a professor of economics at the beginning of the 21st century will feel reassured of the existence of Kondratieff by looking at the rate of growth since 1974—that is, the probable rate of growth till the end of the century. What is happening now and will continue to happen till the end of the century is the confirmation of the statistical existence of the Kondratieff cycle.

But, of course, the difficulty is that, because of changes in the social, economic and political situation from one cycle to another, the interplay of the various factors. I believe, is such that the explanation of Kondratieff's cycle, or the long wave of technological innovation, or a purely Schumpeterian explanation of the Kondratieff cycle, is probably too simple. Mr Macrae was right in showing, for instance, the importance of the change in economic leaders.

Now, I come to the two very important questions raised by Professor Shinohara.

He has raised the question of the relations between the future of technology and the energy ceiling. Personally, first, I would have reservations about the word "energy ceiling," because I am not sure that in the long run there is an energy ceiling. What we shall see in fact is a change in the international economic system. Instead of having regular increases in the price of oil and smooth substitution from oil to fossil and non-fossil energy sources, we shall probably have a series of big price increases followed by some kind of plateau which will be destabilizing to the world economy, and, simultaneously, social resistance within the advanced industrial societies to the introduction of new energy sources.

So what we shall encounter is not exactly an energy ceiling but rather a change in the energy situation.

Secondly, I believe that the energy situation may not necessarily have a negative impact as such on technological innovation in the advanced industrial societies for two reasons. First is the fact that the big new technological "adventures" like electronics and biology generate industrial sectors which are relatively small consumers of energy. And second, the transition from oil to other fossil or nonfossil sources, and more generally the methods of using energy in the industry, themselves give a strong impulse toward technological innovation.

So, I think that energy may be more important to technological innovation through the impact on overall growth, and from growth and capital accumulation into implementation of technological innovation, rather than directly on technological innovation itself.

Will Stagnation Continue?

Moderator: So far, we have centered our discussion on technological innovation, at times, referring to Kondratieff cycle. Now, we would like to enter into the second topic, i.e. "Will Stagnation Continue through This Century." I would appreciate it very much if you would refer more specifically and explicity to the relationship between the potential for technological innovation and the oil import.

Sanuki: We can say that energy constraints are coming to the force in two respects, both in terms of volume and prices. And, whenever the world economies are enjoying a boom, a price hike comes about which dampens the trend of the boom. This is what I foresaw about the future of the Japanese and other economies in a paper entitled "Japanese Economy Is Undergoing Successive Trials" which, in fact, I wrote some years ago on the very same theme of prospects for stagnation.

My answer to this question of "Will Stagnation Continue Through This Century?" is that we have already left the stagnation period and we are now seeing the beginning of the electronics revolution, the beginning of the electronics of the third industrial revolution.

Take for example such rapidly progressing forms of technological innovation as seen in coal liquefaction technology and other technologies aimed at saving energy and the consumption of oil.

In the coming five to six years the US automobile industry will most likely be investing something like $75 billion, and the Japanese industry will be investing somewhere around $30 billion.

In the iron and steel industries, continuous casting and continuous sintering technologies are coming to the fore. These also reduce the consumption of energy.

Another category is in the area of machine tools—numeric control machines, for example, which utilize electronics technology. Through these technologies the rate of defects is remarkably reduced, reducing in turn the cost of parts and components and materials. In these areas, we again see the rapid acceleration of technological innovation.

Thus each period of technological innovation is now being shortened, and has brought about a shorter depreciation period for certain facilities and equipment. And, in a cyclical way, that further accelerates the pace of technological innovation.

Therefore, in the final analysis, capital investments shorten the period of technological innovation while at the same time expanding its scope with ever larger ripple effects.

Therefore, when I consider the question of "Will Stagnation Continue Through This Century?", I find that the answer is far from yes. Rather I would say a third round of growth will start around the end of the 1980s and last into the 1990s.

We see the economic stagnation now because we are probably in a transitional period. However, this sort of temporary stagnation is not caused by the lack of technological innovation. The important factor here is, as Professor Lesourne mentioned, that of social flexibility: Is society flexible enough to incorporate and accommodate technological innovation? Does, for instance, political, religious, racial, or labor rigidity impede the incorporation of technological innovation?

Lack of flexibility in society influences the future of technological innovation and has a short-term stagnating effect on any one economy as well as on the economies of the world as a whole. However it is possible to overcome this through technological innovation stimulated by the constraints imposed by the oil situation, I believe.

To be continued

/25 Jun 81, p 5/

This is the fourth of five instalments of a recent symposium, organized by Tokyo Colloquium and sponsored by The Yomiuri Shimbun, which was held in Tokyo under the theme "The Stagnating World Economy and Technological Innovation."

Participants were Jacques Lesourne, professor at Le Conservatoire National des Arts et Metiers in Paris, Norman Macrae, deputy editor of The Economist, London, Toshio Sanuki, deputy director-general, Research Institute of Capital Formation, Japan Development Bank, Takeo Takahashi, director-general, Economic Research Institute, Economic Planning Agency, and Miyohei Shinohara, professor at Seikei University who acted as moderator.

Takahashi: Before responding to the question of the prospects of stagnation, I would like to refer to the impact of the oil crises. According to the statistics of the year 1980, the energy consumption volume, especially in case of oil, in the US, Western Europe and Japan showed a decline of approximately 10 percent, whereas the GNP growth rate in these areas ranged between minus 0.2 percent and 4.2 percent.

This pattern indicates that energy elasticity vis-a-vis GNP has declined. The reason is composite:

1) a depression stage in the business cycle, and

2) structural change in energy consumption and supply.

Effect Of Oil Crisis

This structural change is significant in the sense that the structural change in the second oil crisis was even more clearly indicated than in the first one. The reason for this is, as Professor Lesourne mentioned earlier, "necessity is the mother of invention." And, as Dr Sanuki pointed out, it seems that this oil crisis has had the clear effect of further enhancing technological innovation.

However, there is one problem in that the impact of oil price increases on consumer countries is different depending on the individual nation. Dr Sanuki correctly stated that Japan has already entered the new era of technological innovation. However, I feel that this is not necessarily true for the world economy as a whole. Moreover, I feel that this situation may become a very major cause for the trade conflict between Japan and other countries.

Certainly there are some other countries besides Japan which have been able to react positively toward the oil impact. One such example is the US. Although the northern industrial area has suffered a crisis and is now in a very stagnant situation, the sunbelt area is becoming very dynamic and increasingly active economically. However, we cannot deny that the oil impact has caused very significant damage to the world economy as a whole.

Now, with these things in mind, I would like to try to respond to the problem whether we can be optimistic or pessimistic about technological innovation.

I myself feel that potentially we can be optimistic about technological innovation. However, whether we can actually implement technological innovation in an ideal manner will depend, first of all, on whether or not we will be able to work out a smooth, mutual relationship on the global scene, and, second, whether we are able to create the economic conditions wherein industrial implementation of new technological innovation can be realized.

I think the outcome all depends on these two factors. Considering these two points, I feel certain that for the near future there is a very high possibility that the present stagnant period will continue for some time.

However, between the impact of OPEC's oil hikes and the efforts by consuming countries to cope with and to overcome them, I believe the situation will gradually change for the better.

Recycling Of Oil Money

Moderator: On this matter of whether stagnation will continue through this century or what will be the trend of technological innovation in the coming twenty years, there seem to be more realtively optimistic views than otherwise. However, I think there exist both optimistic elements and pessimistic elements, and that we should direct our attention to the combination of these elements.

Another element is the possibility of continuous hikes in OPEC oil prices despite the present enormous efforts toward conserving oil. Also, there is the problem of recycling oil money.

The advanced countries should to try to absorb the oil money and recycle it through such official international financing institutions as the World Bank and the Asian Development Bank. If this is done, we can hope to see a smooth recycling of the oil money.

Lesourne: Since I agree with what has been said I shall only present four complementary points. First, when we speak of stagnation we have to be a little careful because we are still speaking of a growing world economy even if it is growing more slowly than in the past.

It is also important to consider what part of the world we are speaking of. Are we speaking of the world as a whole? Are we speaking of the West, the OECD economies, or from the point of view of NICs? Depending on the part of the world we are considering, the perspective is not exactly the same.

My second point is related to the aspects of oil from the point of view of international relations. As we know, we can have three types of crises related to oil. The first type would not really be a crisis because it would be just a smooth increase in the price as a consequence of the depletion of low-cost oil.

The second type of crisis is related to the management of oil reserves by the oil-producing countries, including the search for new deposits and all the measures to manage properly the deposits. One aspect of the risk in this type of crisis is, for instance, that we look for oil, not where the probability of finding oil is the highest, but where it is profitable to get oil. And there is a huge difference between the two.

The third type of crisis is related to political events within the OPEC nations. I think that these political events are even more important than any preconceived strategy of the OPEC countries as a group. The two big oil price increases have been related to the Yom Kippur War and to the Iranian revolution, respectively.

We know that the political structure of the Middle East is fragile and that the existence of oil increases the fragility of these societies because there is nothing that will corrupt a society more than oil riches.

Now on the demand side, I think it is important to separate various groups of countries. Everything that has been said so far has been directed to the problems of the developed countries. The NICs are at the period of their development in which the elasticity of energy consumption to gross domestic product (GDP) is still very high. At the other extreme, the problem of the least developed countries of the Third World is that they are now in a period in which they have to replace noncommercial energy with commercial energy, and for that reason they are also very seriously hit by increases in oil prices.

Of course, the solution to their problem is related to the solution which will be given also to the problem of the recycling of oil surpluses.

The reason why in 1975 the solution of recycling through international banks rather than through international insitutions was developed is because that was the only politically feasible solution, the reason being that it implied no agreements between governments and it was done mainly through the banks of the leading nation, the US.

My third point is that if we want to evaluate the prospect of growth, we must also consider the domestic rigidities in some of the advanced countries at least. These domestic rigidities are quite visible in two of the diseases of present economies. One is unemployment and the other inflation.

I think it is totally wrong to say that unemployment is due mainly to a slackening of growth. This is partly true. but I think that it is also due to the way in which the labor market operates in some of our economies.

Also if we take inflation, some of our countries are more prone to inflation because of the way in which social groups fight to keep their share of the national income and adapt their anticipation to any change of the situation. And, of course, in a situation of great sensitivity to inflation, some government growth policies are more difficult to apply and would take too long to develop.

My fourth and final point is that the risk of irregular, moderate growth is very high. There may be some improvement after 1990 with a higher rate of growth in Japan than in Europe and the US, but maybe less sensitivity in the US to the oil shocks than in the other OECD areas, and still a quicker increase in the NICs than in the developed economies.

Long-Term Shortages

Macrae: My pessimism or optimism about the energy prospects would depend largely on whether governments are sensible enough to pass price increases through so as to discourage demand and encourage supply, but that the bigger worries were about the fragility of the OPEC countries politically, and the bigger worries on the demand side were for the NICs, which, I think, are at the stage of increasing energy use, and for the least developed countries, where I was more worried about wood depletion than oil depletion.

As the last few of those points have been explained by Mr Lésourne and the chairman, I will just make one point on recycling of money.

I am more optimistic perhaps than the previous two speakers that the Reagan administration in the US will have a fairly sensible policy toward the recycling of money. I think it will be much more sensible to apply the political pressure toward making the IMF the recycling body rather than bodies like the World Bank. The IMF does pass out good advice as well as money.

Regarding oil shortages or gluts, I was most pessimistic in the 1960s about oil shortages. Suddenly in the middle of an Arab-Israeli War the price of oil quadrupled, so it seemed to me that instead of a shortage becoming much more likely, a glut became more probable. We were actually presented in Britain in December of 1973 with petrol ration books on the theory that because price had gone up, oil shortage was much more likely.

Our hope was that an increase in price would bring forth increases in supplies of energy as a whole. There I think the results have been much less cheerful than one could have hoped. Part of it is the bad luck that there was a glut of oil, but the second oil shock was caused by Iran exploding from one political situation to another, and then the Iraq-Iran War. So, basically, in Iraq and Iran the political situation has gone much worse than one had expected, although in Saudi Arabia it has stayed more stable than I had expected, and perhaps it is the next shock to come.

But the other depressing fact, of course, has been the restrictions on energy supply in the developed countries themselves. The environmental restrictions against nuclear energy have been much greater than seems to me to be logical. One of our panel was optimistic about a switch to coal. Although there is no pressure against digging coal out of the ground, if you try to burn the stuff in the US you immediately run into enormous environmental restrictions.

Price controls on electricity generation in the US have, for quite a while now, made it uneconomic to build power stations.

You can create a long-term shortage of almost anything if you have price controls and restrictions on supply. We have done that. Almost all countries have done it in housing.

It is just possible that we have moved energy from a free market system when supply balances with demand to a government-regulated system whereby we create genuine long-term shortages, and that could be very serious indeed.

(To be continued)

/26 Jun 81, p 5/

This is the last of five instalments of a recent symposium, organized by Tokyo Colloquium and sponsored by The Yomiuri Shimbun, which was held in Tokyo under the theme "The Stagnating World Economy and Technological Innovation."

Participants were Jacques Lesourne, professor at Le Conservatoire National des Arts et Metiers in Paris, Norman Macrae, deputy editor of The Economist, London, Toshio Sanuki, deputy director-general, Research Institute of Capital Formation, Japan Development Bank, Takeo Takahashi, director-general, Economic Research Institute, Economic Planning Agency, and Miyohei Shinohara, professor at Seikei University who acted as moderator.

Moderator: Now we will take up the third topic of "Multipolarization: The World Economy in the Year 2000," in which we will deal with the question of how to interpret the world economy of the year 2000.

Lesourne: A multipolar world does not mean that all the nations which have certain marginal flexibility have the same flexibility, or that they influence the affairs of the world in the same dimensions.

If we start from this definition of the multipolar world, how will the world GDP be divided at the end of the century?

We tried making this computation at OECD Interfutures project, and to our great surprise, we found that the distribution of the shares of GDP is less sensitive than the absolute values of the GDP per capita.

We came to the conclusion that a possible order of magnitude was that the US economy would represent at that time something like 18 to 20 percent of the world GDP, Japan 10 to 12 percent, the European Economic Community 14 to 15 percent and the Third World as a whole about one-third, or slightly less than one-third, with, of course, huge difference among countries since some of them would have become industrial countries by that period.

Meanwhile, fully developed industrial countries, of course, with great inequality among them, would probably represent something like 12 percent of world population. The very poor regions of South Asia and black Africa would still represent 28 percent of the world population, and in between there would remain the 20 percent in China, and 18 percent in the intermediate countries.

A multipolar world is marked at the same time by the declining regulatory role of the US. It is also marked by the differentiation within the Third World between the countries which are developing and the countries which are still having great difficulties.

Of course, what is important in multipolarity is, I think, the coexistence of multipolarity and interdependence, because the two together create the following situation. For each country, multipolarity creates a situation of unpredictability. In other words, the operation of the international system cannot be predicted easily since it is a result of the behavior of a few significant actors, and it is more difficult to predict the outcome of the strategies of various actors than of just one dominant actor.

An aspect that is related to unpredictability is the vulnerability which derives from interdependence. We have seen that vulnerability vis-a-vis oil in our discussion today, but we could have also discussed the vulnerability of other parts of the world with respect to food or finance. I think that the real challenge is how to manage a world which is at the same time multipolar and interdependent, how each country can face at the same time unpredictability and vulnerability.

Relations Between Various Countries

Sanuki: It seems to me that the direction the multipolar structure of the world takes in the 21st century will be determined in large part by three factors; first, whether or not there is a revolution or other form of internal collapse in Saudi Arabia, second, whether or not coal, LNG and nuclear power can bridge the gap between now and the actual commercialization of new forms of energy, and third, whether or not further relocation of energy-intensive industries from the advanced countries to the developing countries or energy-producing areas takes place.

Of these three points, I would say the third will probably take place the most smoothly while the second will undoubtedly meet various difficulties. It is, at the moment, very difficult to make any prediction about the first.

So, with these premises and conclusions, I would like to make some brief comments about multipolarity and interdependence in the future world.

On the question of East-West relationships, there is a possibility of considerable change. First of all, there will be a great change in the racial composition of the USSR, ie, between the Caucasian Soviet people and the colored people; Islamic people and other people of other races. The ratio of white Caucasians will decline as the proportion of people of other races increases. This will lead to a substantial shift in strength within the Soviet Union in the 21st century, which in turn will greatly effect East-West relations.

Much will depend on just how Eastern Europe, Western Europe and the Soviet Union go about adjusting their interests when that happens.

To sum up, I think the future world will evolve around four axes—East-West relations, the relations among the advanced countries, the relations between oil-producing and nonoil-producing countries, and lastly, the relations among the advanced countries, NICs and the developing countries.

Telecommunications Technology

Macrae: I still do think that changes are going to be more dramatic than probably my colleagues do, for the rich countries first of all. I really do think that an increasing proportion of the brain workers won't have to live near their office in the 21st century. They can live in Tahiti if they want to and telecommunicate daily to the computers and colleagues with whom they work in Frankfurt. To a small degree I do that myself now even.

If I'm in Washington, I do exactly the same work as I do in London and just send it over to London by telephone facsimile. I think this does break down the importance of the nation-state. I think people will live in the area that offers them the sort of life-style they prefer.

As rich people can choose to live where they want, I think that the working classes with less interesting jobs in rich countries will take long holidays. During the past when, with a 4 percent growth rate, you could double the GNP about once every 15 years, everybody used to double their amount of consumer goods. But, now I think we will move to a stage where it is more logical to move towards taking, if not six months holiday a year, at least longer ones than at present, and where people will maybe have two jobs, one in one part of the year and one in another, and move about in that way. That's the cheering part of the view.

As regards the communist world, I genuinely believe that communism in its present form probably won't long outlast this century. I think communism has failed as an economic system. I think it has failed as a system for giving happiness to people. However, the period during which it is breaking down could become very dangerous. I believe that the sort of things that are happening now in Poland will spread to Russia.

One of my scares used to be the fact that of the 160 countries in the world, even now over 100 are ruled by dictators who go to bed every night with the fear that they might be hung with their families before breakfast the next morning.

And I thought that the world would be in a rush to see whether that situation could be rectified before nuclear bombs got into their hands.

The Russian situation is now getting very scary. I think that across the Soviet empire the rulers are going to be increasingly fighting a revolution.

Therefore, politically, we face a frightening 20 years. Economically, however, I am much more cheerful than most people, especially for Asia, where I think the NICs are breaking through to a Japan-type of growth.

Japan's Role

Takahashi: I would like to focus my comments on the role to be played by Japan in a multipolarizing world.

One very important task for Japan is that of doing her utmost to use her economic power to contribute to world stabilization.

I believe that the Japanese economy has three main features which could prove of value in carrying out such a task. The first is the Japanese trade structure. Japan's transactions with Third World countries total about 50 percent of her total external trade volume. This percentage is the highest among the advanced countries. This means that Japan has a stronger relationship of interdependence with the developing countries.

The second feature is that the modern development of the Japanese economy has a history of only a hundred years, which means that in the relatively near past, Japan herself was a developing country. This places Japan in a position to make a greater contribution in her relationship with the developing countries.

The third feature is related to the transfer of technology. Technology in the US and Europe more or less goes through a process which begins with a certain concept of objectives and then moves toward commercializing that concep in order to respond to economic and social needs.

In Japan, on the other hand, what comes first is the economic and social need which is studied for the purpose of discerning how new technologies can be applied to meet it. Because of this Japanese technology is quite often criticized as being intermediate, or imitative, technology.

However, I would say rather that what we have brought forth is a new type of technological innovation. In a nutshell, it is this form of technological progress we have in Japan which is best suited for carrying out technology transfers to the developing countries.

In light of these three features, I think it can be said that the Japanese economy is excellently endowed with conditions that will permit Japan to make a great contribution to improving the economies of the Third World as well as of countries of the Eastern bloc.

It is my conclusion that, assuming that the potential of the Japanese economy is to be used fully and advantageously, Japan is in a good position to contribute toward improving the world's economy, while at the same time bettering her own economy as well.

Moderator: I think we can say that in terms of economic cooperation in the private sector, Japan has contributed greatly to promoting the horizontal division of international labor. I also believe that, when it comes to economic cooperation within the Asia-Pacific region, Japan can play a significant role. However, I feel that 20 years from now, economic cooperation for the sake of basic human needs in the Asia-Pacific region will probably very seldom occur.

So, my outlook coincides with the conclusion of the Interfutures report.

So, I strongly feel that it is now time for Japan to get meaningfully involved in the field of Official Development Aid (ODA) toward other areas such as Africa.

Circles Of Cooperation

Lesourne: It might be interesting for me to give a European view of possible European reactions towards multipolarization. But my views are strictly my own.

Sometimes I speak of the "circles of cooperation." The first circle for the Europeans is of course Europe itself, and encompasses problem of dealing with the consequences of multipolarization for Europe and of the differences in the speed of adjustment of the various European economies.

The second circle of cooperation is what I call the "triangle"—Western Europe, Japan and the US. This triangle seems to be confronted with three major challenges. First, relations with the Eastern European; second, the changing role of the US and; third, the differentiation found within the Third World.

Two sides of this triangle, are pretty strong,—US-Japanese relations and the European-US relations — I don't mean that there are no problems, but there are regular, on-going relations.

The third side of the triangle is very weak, and this side can be considered, especially from the European point of view, as purely trade relations. I think the major task for the Japanese and Europeans is to imbed progressively these trade relations into a broader context.

The third circle is represented by the NICs. Europe is less advanced, in its economic relations with the NICs. But I think it is very important that the OECD does not remain a closed club and in some way reject the middle class of the world economy which the

NICs represent.

These countries' developing close and friendly relations with the OECD countries is in the very long run essential to the world's political stability.

The fourth circle is represented for Western Europe by two parts of the world with totally different problems. One of these parts is composed of the Arab countries specifically, and more generally by North Africa and the Middle East.

Of course this region is for us as for Japan, the key oil production region, at least at present, but it also a region which is very close to us since it is the other border of the Mediterranean area.

These countries have major problems before them. They have not only to replace oil by another source of energy but to replace oil by other sources of income. They are in a very fragile political situation.

The other part of the fourth circle is Black Africa, one of the poorest regions in the world. It is also a re[illegible]n with which Europe has had very strong ties in the past, even though they were ties of colonialism. This region is in a very delicate situation, since many of the countries are small and the governments are not always able to manage economic development.

This leads us to the fifth circle which is represented by the other poor countries of the Third World. Here certainly, as in Africa, we have to cooperate with other developed countries in order to try to develop and concentrate aid in this part of the world.

The sixth circle is China. In spite of China's size and very great importance in the long term, its economic importance over the next 20 years is still probably limited for Europe, though, of course, its political importance has some significance in relation to the Soviet Union.

Finally, the seventh circle is Eastern Europe. I totally agree with Norman Macrae in that there is a need for a policy combinig a firm military position with a certain openness, because the evolution of internal and external situation of the USSR can lead either to great prudence among the managing circles of that country or to some kind of adventurism. We have to be very careful in dealing with this situation. Of course, here our interests are very similar to the interests of Japan since with Japan we share three fundamental interests in life: an interest in the prosperity of the world economy, an interest in security and an interest in democracy.

Concluded

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SCIENCE AND TECHNOLOGY

OPTICAL FIBER COMMUNICATION AGE ARRIVES

Tokyo ASAHI EVENING NEWS in English 23 Jun 81 p 3

[Article by Shunichi Takebe, deputy science editor, ASAHI SHIMBUN]

[Text] The age of optical fiber communication is dawning and Japan leads the world in optical fiber technology and the the development of the semiconductor laser beam as a light source. Glass fibers as fine as human hair will be used instead of copper wires for communication transmission lines and the latest in this technology will be applied to the telephone system. From this spring, the Nippon Telegraph and Telephone Public Corporation is undertaking to install optical fiber cables in 12 areas across the nation.

In ancient times, people communicated by using the light from signal fires and pine torches. But with the development of telecommunication technology in recent years, electric cables and radio waves came to play leading roles. The coaxial cable, a transmission line that consists of a tube of electrically conducting material surrounding a central conductor held in place by insulators, and high-frequency microwaves are used to transmit many telegraph, telephone and television signals at one time. With the advent of the age of communication of information on screens, wide-band transmission lines came to be sought more than ever before. That is why light made its reappearance—in the new form of the laser beam, the "light of modern science."

Application of the laser beam, which was made artificially in the 1960s, to optical fiber communication was expected from the beginning. This is because the laser beam could transmit a large amount of information since it has the same characteristics as radio waves and because its frequency is extraordinarily high. It is said capable of sending 10 million megabits of signals per second. It has a capacity that is more than 100,000 times that of very high frequency (VHF) waves used in FM broadcasting.

When released "naked" into the air, the laser beam is absorbed in the atmosphere and becomes weak. So, a method was devised to let it "run" in quartz (silica) glass fiber with a diameter of about 0.1 millimeter. A race got under way among various countries to develop an infinitely transparent optical fiber. During the past few years, high-performance fibers have been made in Japan.

One VAD single-mode optical fiber, developed by the NTT last year under a new manufacturing method called the vapor phase axial deposition method, has a capacity of 480,000 telephone circuits. It boasts of high purity capable of linking a distance of 15 kilometers without repeaters. This technology is attracting worldwide attention as a method for producing optical fibers in quantity at low cost.

Until some time ago, the light of a wavelength of 0.85 micron (infrared rays) developed in the U.S. had been deemed good as a laser beam for fiber communication purposes. However, its capacity would be weakened by half for every kilometer in distance. In their quest for a low-loss wavelength band, Japanese technicians developed a semiconductor laser beam, an ideal source of light, in the 1.3-micron and 1.6-micron bands. Loss in this case is only about 10 percent for every kilometer.

Optical fiber communication circuits for practical use are being installed in 12 areas in 10 prefectures, including Tokyo, Osaka and Aichi, for a total distance of about 110 kilometers. Telephone exchanges and relay stations, which are separated from each other by a distance of about 10 kilometers, will be connected by medium-capacity circuits (equivalent to 480-1,440 telephone circuits). Although its loss is somewhat high, a 0.85-micron laser beam, which has a life span of 500,000 hours, will be used chiefly. A low-loss laser beam of 1.3 microns will be tested in three areas.

Meanwhile, a test in which a large-capacity trans-mission system using single-mode optical fibers will be put to practical use is scheduled to be conducted in an 80-kilometer distance between Tokyo's Musashino City and Kanagawa Prefecture's Atsugi City.

Similar applications of optical fiber communication had already begun in small communities, such as in the two-directional television communication in Nara Prefecture's Higashi-Ikoma area. However, its use in telephone circuits followed experiments in Atlanta City, Georgia, in the U.S. The British Telecom Co. of the United Kingdom has announced a plan to build an "Optical Cable Town" by introducing optical fibers in broadcasting and the telephone service next year. The raw materials used to make the optical fiber are sand and other materials that are plentiful, so a substantial reduction in cost can be expected if manufacture goes smoothly. The day may eventually come when glass lines will be drawn into private homes.

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SCIENCE AND TECHNOLOGY

TOP SIX FIRMS STRATEGIES IN BIOTECHNOLOGY RUSH REVIEWED

Tokyo SHUKAN TOYO KEIZAI in Japanese 2-9 May 81 pp 108-117

[Text] A biotechnology rush is on with the concerted effort of government and private concerns.

It is a natural course when one considers the fact that biotechnology has the feasibility to bring about great technological innovations toward the 21st century. Private concerns are struggling for survival in the intercorporate race with an effort to improve productivity and develop new products by practical use of this technology without a moment's delay. The government too is showing a posture of tackling with biotechnology as a national project.

Biotechnology is an important technology for Japanese industry to maintain its position "As Number One" and to make its way.

Biotechnology is an applied technology using microorganisms. It is a general term for a technology using various functions of microorganisms, and it is said to be applicable in all fields where microorganisms are involved.

New techniques in biotechnology that are currently attracting attention can be categorized into four areas: (1)bioreactors (an industrial application of biological reactions), (2) mass cell culture technique, (3) recombinant DNA technique, and (4) cell fusion technique. Of these, recombinant DNA and cell fusion have become frequent topics. In particular, recombinant DNA is currently the biggest focal point.

Fields of biotechnological applications are very extensive and include medicine, food products, chemistry, mining, resources and energy, agricultural, fishery and livestock industries. Several feasibilities referred to include the development of new pharmaceuticals and food products, lowering cost by mass production, improvement of mineral refining rate using microorganisms, development of new fuel based on biomass, creation of plants requiring no nitrogen fertilizer, etc.

As for the current state of research and development using recombinant DNA technology, the Euro-American countries, especially the United States, are taking the lead ahead of Japan, Interferon, insulin, growth hormones, etc have already been successfully developed without a delay by Euro-American firms such as Genentech, Lilly, Roche and others using genetic engineering technologies.

In October of last year, a genetic engineering firm, Genentech, in the United States publicly offered its stock at a price of $35.00 a share. The initial transaction price shot up to $89.00 after only 20 minutes, making the president, Swanson, a rich man with assets of nearly 2 billion yen in a short time. Such an incident will probably be told to later generations as an anecdote to describe the opening of genetic engineering.

In addition, Euro-American [sic] countries have undertaken genetic engineering as a national project. In England, a semigovernment, semiprivate biotechnology specialist firm, Celltech, was founded in November of last year; and in France, too, a government-civilian collaborating firm, Transgene, had its start early this year.

In opposition to the Euro-American [sic] government-civilian joint research structure, Japan has finally begun with the formulation of a research structure.

At MITI, a biotechnology symposium began and research and development will be undertaken jointly by the government and private concerns with a 10-year plan from JFY 1981 to 1990. A little more than 30 billion yen is estimated as the overall research and development expense, and 675 million yen was secured as the JFY 1981 budget. Survey questionnaries from the private firms of the symposium members have been collected. After conducting a survey hearing, research projects and target firms will be selected within 3 months at the latest to determine the course of research.

In addition, the Ministry of Education, Science and Technology Agency, Ministry of Health and Welfare, and the Ministry of Agriculture, Forestry and Fishery are also advancing their independent biotechnology-related programs. To be on the same track with these administrative movements, 5 firms, Mitsubishi Chemical, Mitsui Toatsu, Sumitomo Chemical, Asahi Chemical, and Kyowa Hakko, organized a "biomass symposium" in October of last year and are working to obtain government support for basic research.

Meanwhile, in March, at the Federation of Economic Organizations, a life science symposium (committee chairman, E. Suzuki, president of Mitsubishi Chemical Industries) was organized joined by approximately 70 firms.

Guidelines to advance research and development in genetic engineering (as a physical containment guideline, experimental facilities in 4 levels, P1-P4 are stipulated in order to prevent the hazards of spreading microorganisms) were set 2 years ago in Japan. In the United States, the NIH [National Institutes of Health) published the first guidelines in 1976, and in January this year, it announced the third stage relaxation of the guidelines. Voices seeking relaxation are also increasing in Japan, and the genetic manipulation council (consists of 17 scientific societies such as the Japanese Society of Biochemistry, represented by H. Uchida, Professor of Tokyo University) submitted a guideline revision proposal to the Council for Science and Technology (Advisory organ of the Prime Minister's Office) and the Ministry of Education based on the judgment that the hazards of genetic engineering are less than anticipated. Thus, a direction toward relaxation sooner or later is expected.

In the midst of these activities, a move to collaborate with overseas firms in genetic engineering has already been shown in the industrial circle. In addition, a move to recruit Japanese scientists in the United States is also active. Trading firms such as Mitsui & Co are also playing a role in the trade agreements with overseas firms.

Japanese fermentation technology is a leader in the world, and catching up with Euro-American technology will be swift once it is set out in a full-scale motion. However, in reality, the goal of biotechnology is still vague, and the industrial circle is feeling its way. The biotechnology race has just begun.

Green Cross

Rapid Development in Agreement with a U.S. Firm

Green Cross's undertaking in biotechnology has become even more fervent. It advanced to a new stage of "contemplating an investment" (R. Naito, chairman) in the American firm specializing in biotechnology research, CRI (Collaborative Research Incorporated) with which it is closely associated, in order to prepare for acquisition of the first option right to importation and commercialization of research results. Agreement between the two firms seems to have been made, and it will probably materialize sooner or later.

Recently, the relation between Green Cross and CRI has rapidly become closer. It began with the receipt of technology to mass-produce a thrombolytic enzyme, urokinase by cell culture and its exclusive distributorship; then in February, it commissioned research on a variant strain of yeast to produce interferon by recombinant DNA. In addition, the firms signed a contract for Green Cross to receive, beginning in April, a monthly supply of 1 billion units of interferon-β of cultured fiberblast origin.

Green Cross has strength in blood-related work and makes macromolecular drugs its speciality. It took a lead in the interferon production from leukocytes or cultured lymphoblastoid cells simply because it is within its field. However, as a result of the unexpectedly rapid development of recombinant DNA technology, their concern has intensified that they may fall behind in mass production technology which is essential to determine a wide range of indications. Their measure to recover that "lost ground" has been manifested in a lean toward gene splicing by recent collaborative agreements made one after another.

In addition, the raw materials for their principal products include proteins and enzymes dependent on natural organic substances such as plasma, human urine, carbohydrates, vegetable oil, colloids, etc. With plasma and human urine in particular, difficulties may be encountered in procuring the material. Biotechnology surfaced as one of the replacement measures. For that reason, they must inevitably undertake biotechnology seriously in order to stabilize their foundation.

For example, the major product of the firm, urokinase, currently requires human urine as the raw material. Furthermore, there is the possibility of developing bottleneck problems with materials in the process of extended distribution. Moreover, they say that the cost will be reduced to less than one-half when the cultured kidney cell technique imported from CRI is employed. Commercialization using this process is expected to be 3 years off since 1 1/2 years is required before application for manufacturing can be approved.

In February, concurrent with the collaborative agreement with CRI for mass production technology using recombinant DNA, they also signed an agreement with Genetech, a bioengineering research specialist in the United States, for mass-production technology of the human serum albumin, a type of plasma protein essential to the human body (isolation and fixation of variant strain of E. coli). In the case of albumin, the same problem in both material and cost can occur as with urokinase. Commercialization of albumin by gene splicing will be 4 years off if everything goes smoothly.

For the moment, the development of interferon is the focal point. They expect to obtain a variant strain of yeast from CRI in May. Then, the plan is to begin immediately with extraction and purification if interferon (γ). As a preparatory step, come April, they plan to make a serious effort in elucidation of the antineoplastic characteristics of the three types of interferon in hand: γ-type (monthly production of 2 billion units by leukocyte extraction, monthly production of 2.5 billion units using cultured lymphoblastoid cells), γ-type (possible error for β-type - see 2nd paragraph under Green Cross] (purchased from CRI), and α-type (1 billion units purchased monthly from Key Pharm in the U.S.). With the leukocyte extraction process, they plan to apply to manufacture interferon at the end of April for applications in viral retinitis and conjunctivitis.

In spite of their statement that development in biotechnology "is not to be limited to genes alone," (Chairman Naito), it is a fact that Green Cross has fallen behind in genetic engineering and is supported by collaborative agreements. Another step is also needed in fermentation technology. Although they are making efforts for rapid gains by bringing in talents, etc, considerably more effort may be necessary for independent development.

Takeda Chemical Industries, Ltd.

Agreement With Roche--A Turning Point for Full-Scale Work

Under the collaborative agreement with Hoffmann-La Roche, one of the world's leading pharmaceutical firms with headquarters in Switzerland, the firm decided to make a serious effort in the commercialization of interferon (α-type) by gene splicing. It is the first shot in the realization of their strategy stated as "by all means, we wish to acquire a perfect command of biotechnology within the next 3 years." (Managing director, E. Omura, director of the Central Research Lab)

Takeda had already constructed a physical containment facility of P3 level 8 years ago, and it is expanding the facility. Initially, it was used for cancer virus research. In the course of study on carcinogenesis, a hypothesis was established that cancer may change the genes of the cells. Thus, they withdrew that gene and are trying to discover the region of carcinogenicity by excision work. In the commercialization process for the seasoning "Inoichiban," they use the technique of nucleic acid degradation. Although not in a mature form, they early had their hands in genetic engineering.

The current agreement is for Roche, Japan, the Roche corporation in Japan, to import the technology and make a joint development. The splicing technology is from Genentech in the U.S., but La Roche, USA began clinical testing in the states in January heading for commercialization. Takeda and Roche are scheduled to construct separate plants aiming at completion next spring. Apparently, details have not been worked out, but the plan is to develop jointly not only the α-type, but all three types of interferon in the future including β-type and γ-type (antigenicity and molecular weight are different).

Advantages for La Roche include lowered cost through parallel development, risk diffusion, and the use of Takeda's fermentation technique which is at the world's top level. In fact, Takeda alone in Japan was able to export overseas petroleum fermentation technology. Moreover, they supplied Roche with a rubose production technique they developed independently. On the other hand, for Takeda, the agreement becomes a strong lever to push the level of applied research in recombinant DNA.

Takeda's biotechnology is being developed centered around the fermentation products laboratory and biological laboratory. And, although they have their hand in cell fusion, etc, the principal, immediate fields are recombinant DNA and cell culture. Furthermore, they have, more or less, narrowed their field to the development of pharmaceuticals.

With differences in emphasis, they seem to have also begun working in fields where applied research and development are being advanced worldwide such as the creation of new bacterial strains, process improvement in the field of antibiotics, hormones such as insulin, growth hormone, etc, human serum albumin, antineoplastic agents, enzyme preparations, etc. "Without delay, without hurry" is their basis for a developmental posture, but more collaborative agreements with overseas firms are plausible.

Kyowa Hakko Kogyo

Pursuit of U.S. Firms With Strength in Fermentation Technology

Kyowa Hakko has a top level technology in the production of amino acids, enzymes, antibiotics, etc by fermentation technology. In 1956, they established a production technology for glutamic acid using a metabolically controlled fermentation process. They have accomplished an opening of the way for mass production of amino acids.

In order to further develop this fermentation technology, combining with genetic engineering technology becomes a major project. This research is mainly being done at their laboratory in Tokyo. At the above laboratory, a P3 facility was built in December of last year, and research groups for physiologically active substances and microbiological culture, were organized to conduct biotechnology-related research.

Training of staff talents for these research groups goes back to sending them abroad about 5 years ago to acquire technical expertise in American universities. Research members have been dispatched every year since. Researchers are also sent to Japanese research organizations such as the Institute of Physical and Chemical Research and the Institute of Applied Microbiology in an effort to strengthen their research groups.

The immediate goals are narrowed to origination of pharmaceuticals using genetic engineering techniques and research and development of a bioreactor using fixed enzymes.

Among the pharmaceuticals, those prepared by using microorganisms such as antibiotics, amino acids, etc can be sufficiently upgraded in yields by improving existing methods. A reduction in cost is also possible. Thus, they are passive in their production by genetic means. Rather, they are aiming at useful substances among immune system activators such as physiologically active substances (peptides, hormones, etc), interferon, etc and immunological preparations used for clinical diagnostic agents. However, they do not intend to handle drugs such as insulin whose effectiveness as a therapeutic for diabetes is clearly known and where American firms are leading, since they sense that this competition is over.

The method chosen as the fastest way is to create new substances by cell fusion and produce them with tissue culture techniques where they have accumulated technical expertise. Thus, emphasis is placed on research in that direction. Their plan is "to create substances with cytoengineering techniques, and when their efficacies are confirmed, and mass production becomes necessary from the standpoint of trends in demand, then we can use recombinant DNA" (managing director, Sameshima).

Creation of new substances using cytoengineering techniques can probably be accomplished in the next 1-2 years. However, the commercialization of pharmaceuticals requires various tests for safety and clinical use as well as application to the Ministry of Health and Welfare for a manufacturing license. Thus, it would take at least 3-5 years.

In comparison to pharmaceuticals, bioreactors seem to be faster to develop for practical use. This is a system to fix enzymes for continuous production. This is a field most related to fermentation technology where microorganisms have been used. They have already developed a process to produce malic acid which is used as a pharmaceutical raw material, from fumaric acid by fixing a thermostable enzyme, and it is in actual use. They also developed a bioreactor for the continuous production of alcohol from a sugar solution, etc by a fixed yeast growth process. They plan to aim for practicalization at about 10 kiloliters within 2 years by constructing 2 reaction towers of 1 kiloliter capacity by early 1981 and making improvements.

In genetic engineering technology, American firms are taking the lead with insulin, interferon, growth hormone, etc, and it is undeniable that Kyowa Hakko is a step behind them. However, biotechnology research based on fermentation techniques has made rapid progress, and their confidence is such to state "we have acquired a certain degree of gene-related techniques that are presently known" (Sameshima). They seem to have already applied for several patents turning to roll-back tactics.

Meiji Seika

Collaboration and Patent Application in Genetic Engineering

Japan is a prominent antibiotics producing country in the world. Meiji Seika undertook the production of antibiotics in 1945, and it now occupies a position as one of the five foremost producers in the world.

During the long experience, improvement of bacterial strains for antibiotics production has been studied constantly from the aspect of genetics of the microorganisms. In that sense, it may be said that they have a certain degree of groundwork for genetic manipulation technology.

In addition, they imported one of the biotechnologies, a cell fusion technology in the latter 1960's and have been working with improvement of seedlings using that technology.

For Meiji Seika, the targets of biotechnology include (1) drastic upgrading of productivity for antibiotics, (2) improvement of production technology systems, (3) development of new antibiotics, and (4) the discovery of physiologically active substances of the body.

In order to achieve these goals, research and development structure have been considerably strengthened since last year with emphasis on genetic manipulation technology and cell fusion technology.

During the first half of last year, the central research laboratory, the laboratory for fermentation technology, and the laboratory for drug development were organizationally unified into one, and a committee was also organized in the company in order to promote biotechnology research and development. In addition, a P3 facility of the highest level among private firms was imported for the central research laboratory last spring.

With respect to training of staff, they began sending young researchers to research organizations both at home and abroad in the early 1970's, and the talents for biotechnology research have now increased.

Although realization is yet to be seen, many improvements in the production technology for antibiotics using cell fusion seem to have been accomplished already. The next step in the research project is to determine whether or not genetic manipulation technology is applicable to the synthesis process.

In the case of Meiji Seika, improvements in antibiotics production technology using biotechnology are expected to show effectiveness in the production of agricultural chemicals.

A noteworthy item is the herbicide MW801 for which they plan to apply for a permit within this year. It is the first herbicide in the world manufactured by a fermentation process, and its efficacy is considerably higher than conventional products. It appears that they have received inquiries for collaborative agreements from nearly 20 overseas firms. This herbicide is not directly related to genetic manipulation, but there is a possibility that biotechnology may be applied in the future on its extended line.

Currently, Meiji Seika has a fermentation tank capacity of approximately 4,500 tons. When the production system for antibiotics is improved in the future by the application of genetic manipulation and cell fusion technologies, and mass production techniques are developed, it is not unlikely that the tanks growing in size will disappear from the factory.

The structure of antibiotics is said to be more complex than those of insulin or interferon. This is the big reason why the results of genetic manipultion involving antibiotics are almost entirely absent on the surface.

However, a promising research result was disclosed in early April. Dr M. Okanishi of the [Japanese] National Institute of Health developed a host-vector system using actinomycetes.

It appears that Meiji Seika has a research relationship with Dr Okanishi. At any rate, that such a development has been accomplished will greatly contribute to upgrading the production efficiency of antibiotics.

For now, we should note their movement on collaborative agreements and patents. Several cases of collaborative inquiries have arrived to Meiji Seika from overseas genetic engineering firms, and there is the possibility that agreements will materialize this year. In addition, Meiji Seika has been suppressing patent applications related to genetic manipulation for strategic reasons, but it appears that two cases of patents are being applied for in the near future.

Mitsubishi Chemical Industries

Achievements in Basic Research Using the Life Science Research Institute as a Lever

Mitsubishi Chemical's evaluation of genetic engineering is high. In particular the company has a subsidiary, Mitsubishi Life Science Research Institute (director Niwa), and it is acknowledged that they are on a first class level in Japan in the field of basic research. At the above research institute, they also proudly state "we have power in recombinant DNA." (director, Niwa).

This Life Science Research Institute is in charge of basic research, and the general research institute (includes biochemistry research laboratory) takes over. In addition, the Life Science Office established in October of last year has a function to plan industrialization as a control tower over the research institutes.

Thus, the company's research and development structure for genetic engineering has a third dimension with the Life Science Research Institute at the base. The number of prepublication patent cases related to genetic engineering in Japan as of December of last year totaled 26 for all Japanese firms. Of these, seven cases were held by Mitsubishi Chemical, leading all others, such as four cases by Institute of Physical and Chemical Research, four cases by Ajinomoto, and three cases by Noda Sangyo Science Institute (Kikkoman group). Moreover, the substance of the patents are said to be of a high level such as a method of adjusting plasmids (extrachromosomal genes) and a method to improve yeast strains.

Regarding the fields of application for genetic engineering in the future, "even if the yield in the chemical reaction process is upgraded 1-2 percent by biotechnology, it is a great contribution for a chemical firm. (W. Yamatani, chief, Life Science Office, Development Headquarters).

Therefore, the basic policy is "to advance steadily since it is difficult to replace everything in the chemical field with biotechnology." (chief, Yamatani)

In the pharmaceutical field using genetic engineering, a technology has been established to have E. coli manufacture physiologically active substances such as hormones made in the human body, and the policy is now to plan for its practical use. They would like to begin clinical work in about 3 years.

In the applied fields, targets are chemistry, pharmaceuticals, agricultural chemicals, fertilizers, and foods. However, they all need time for commercialization and will not contribute to profits quickly.

The Life Science Research Institute that may be called the key point of genetic engineering, was founded 10 years ago by the late President Shinoshima, The first director was F. Egami, who is currently the director emeritus and an authority in molecular biochemistry. Director Niwa succeeded the former director Egami in October of last year. Mr Niwa was a vice president of Mitsubishi Chemical until then. The assumption of the directorship by Mr Niwa may be interpreted as spurring the institute for research and development with commercialization feasibility.

The Life Science Research Institute is surely "recognized worldwide as an academic member similar to universities, and research organizations." (chief Yamatani). It is also a place of information gathering from its achievements and exchanges among researchers. However, for Mitsubishi Chemical that pours 2 billion yen annually into the Life Science Research Institute, it is natural to expect more of the results.

Research achievements of the institute in the past are rich: discovery of a restriction enzyme that cuts RNA (ribonucleic acid) into a proper size, successful creation of a thermophile bacterium that grows at 80-85°C by splicing DNA in E coli. Patents are also based on the research done at the Life Science Research Institute. However, business strategies and academics did not always tie together smoothly in the past.

In the midst of cries of the petrochemical industry's structural crisis in Japan, Mitsubishi Chemical's expectations on advanced technology such as genetic engineering and C_1 chemistry are great. The recent collaborative agreement with Key Pharmaceutical in the United States and collaborative agreements with and stock acquisition from Nikken Kagaku and Tokyo Tanabe Seiyaku are measures to strengthen the pharmaceutical field, and may be regarded as a declaration for a full-scale blossoming period for genetic engineering.

Ajinomoto

Basic Goal Is Upgrading of Amino Acid Productivity

Ajinomoto is a top amino acid manufacturer holding 60 percent of the Japanese market and a 70 percent share of the world market.

Amino acids are the basic substances that control life, and technological accumulation in intensive amino acid applications is the source of business for Ajinomot.

Accumulated amino acid technologies are piled high, ranging from synthesis technology, extraction technology, analysis technology not to mention fermentation technology.

By introducing genetic engineering on top of these existing technologies, the efficiency in research and development will be further upgraded, and a power to produce new products will also be increased.

R&D at Ajinomoto is being advanced with the central research laboratory as the nucleus. Under the central research laboratory, there are three research divisions: microbiology department, chemistry department, and analytical research department; as well as three research laboratories: technological development laboratory, food development laboratory, and biological science laboratory.

Naturally, they have already incorporated a P3 facility of the highest level among the private firms, based on the guidelines.

"Although the door to genetic engineering has just been opened, by no means, do we wish to be beaten by other firms" (director, T. Kauta). Stating thus, Ajinomoto has clearly shown its positive fighting posture in the genetic engineering of amino acids as the leading amino acid manufacturer in the world.

Consequently, the acquisition of patents has also increased. They have four cases of prepublication patents related to genetic engineering between 1971 and 1980. This number is the second highest among the Japanese firms next to seven cases held by Mitsubishi Chemical.

Included in the four cases of patents is a patent for a culture method of microorganisms where only the specific genetic information in the microbial cell is increased, thus selectively increasing the production of a substance coded to be produced by that genetic information. In addition, they have acquired patents in European countries such as France and West Germany, on several of their patents.

Their greatest emphasis is focused on the fact that the immediate target of Ajinomoto using genetic engineering is the upgrading of amino acid productivity.

When mass production and lowered cost are realized by upgraded productivity, the minituarization of production plants is also conceivable in the future.

It was disclosed at the end of last year that they developed a technique to double the production efficiency of one of the essential amino acids threonine, by genetic engineering using a new strain of E. coli.

They have also developed a technique to prevent loss of inserted genes which is considered to be the problem point in applying genetic engineering to actual production.

In the future, biotechnology with genetic engineering as the main entity will be applied to the development of new food products, the improvement of existing products, and the development of pharmaceuticals which is beginning to show a full-scale unfolding.

In the development of pharmaceuticals, Ajinomoto does not show much interest in interferon, etc.

However, in studying antibiotics, they seem to be examining the application of genetic engineering. As for anticancer drugs, the application of genetic engineering is likely to become a future project for investigation since a majority of the drugs are based on aminoglucoside.

Other Major Firms

Firms Swarm on Ringen Seiken

Recently, it is said that a "Ringen pilgrimage" is being made. The reason is that Ringen Biological Chemical Research Laboratory (capital of 1 million yen) has succeeded in the mass production of interferon and has begun production. The laboratory is a subsidiary in the field of life science development of Ringen (capital of 100 million yen) whose main office is in Okayama.

The method used by Ringen is to transplant transformed lympholastoid cells (α-type) into newborn hamsters, to culture and isolate them instead of cultivating the cells in a tank. The cost is lower and mass production is possible. A hamster breeding house was completed at the end of January at Fujisaki laboratory and production began. An average of 50 million units of interferon is obtained per hamster. At present, approximately 2,000 hamsters are grown at the breeding house. Although not all of them are interferon breeders, it appears that they can manufacture more than 300 billion units a year. It is the largest scale production in the world. Furthermore, they plan to increase the number of hamsters and breeding staff in the fall and increase the yield also, which is likely to nearly double the production capacity. The destinations for supplies have been also decided as Pasteur Institute in France, Mochida Seiyaku, and Otsuka Seiyaku.

Otsuka Seiyaku which has a collaborative agreement with Ringen for interferon commercialization, is conducting research at Tokushima laboratory with emphasis on cytoengineering. They narrowed their target to pharmaceuticals and are putting their efforts into creating glucopeptides (physiologically active substances) by cell fusion, etc.

Although the staff working with cell fusion at Tokushima laboratory is small (10), they are advancing research in cooperation with their subsidiary, Nihon Kotai Kenkyusho [Nippon Antibody Research Laboratory] (Takasaki) and Ringen Bio-Chem Res, universities, etc. Although they have not begun gene splicing, they have a plan for building a safety center in the laboratory this year and are considering the installation of a P3 facility.

Mochida Seiyaku also has a collaborative agreement with Ringen Bio-Chem Res. They plan to work for commercialization of lymphoblastoid interferon using hamsters, that is safety testing and clinical trials through a collaborative agreement. The immediate plan is to develop the drug by narrowing down to hepatitis B and herpes encephalitis.

In addition, the company established a production technique for immuno-diagnostic agents for pregnancy using a cell fusion technique and have the prospect for commercialization in 1-2 years. It involves the fusing of lymphocytes of a mouse with myeloma, a type of cancer, and lymphocytes taken from a healthy mouse by cell fusion to create new lymphocytes and culture them in a tank. When this method is used, the cost can be reduced considerably compared to the conventional method. In addition, they obtained fibroblastoid cell interferon (β-type) from G. D. Searle & Co, in the United States by technical importation. To that end, they dispatched researchers to Searle for technical acquisition and constructed a mass production plant in the Shizuoka factory. By summer, they plan to begin production at about 3 billion units monthly.

Kikkoman is conducting research and development at the central research laboratory and Noda Sangyo science laboratory. Of these, research related to biotechnology is mainly done at the Noda Sangyo laboratory. A cell wall-fusing enzyme, pectoliase [transliteration] Y23 is a product which has been distributed not only in Japan but exported to many overseas countries. In addition to the accumulatedd fermentation technology for manufacturing soy sauce for many years, they are also conducting genetic manipulation research. However, it will be a while before they can obtain specific results. They have a P2 level facility.

Kanegafuchi Chemical recently completed a P3 facility as part of their strengthening of the biochemistry research laboratory (80 percent of the 100 staff members are involved with pharmaceuticals), and serious efforts are being made to establish gene splicing technology.

Application fields of emphasis are still fluid, but the pharmaceuticals area is one of the strong candidates. They extracted glutathione, a primary substance for a liver drug, from yeast, they incorporated a microbial fermentation technique into the manufacturing process of HPG, an intermediate raw material for synthetic penicillin, whereby they succeeded in lowering the cost by about 40 percent compared with the conventional process. Thus, they are skilled in technology essential in commercialization which will probably become their field of emphasis.

For now, the focal point is likely to be an improvement of manufacturing processes of primary substances for antibiotics and the production of new bacterial species.

Mitsubishi Petrochemical developed a technique to produce a kind of amino acid, L-aspartic acid at high yield by using a bacterium that grows by feeding on ethanol.

Using SCP (microbial protein [possibly "single-cell protein"]) research and development as the fertile ground, the company is conducting research on the subject of bacterial cultivation and a technique to improve bacteria. The above new process is also based on such work.

L-aspartic acid is used as a raw material for food and pharmaceuticals. Full-scale participation of the company in such a field of amino acids is also expected in the future.

Tanabe Seiyaku that developed the manufacturing process of L-aspartic acid using fixed bacterial cells and exclusively produces it, is leading in the fixed enzyme technique. They have freely used this technique in the production of amino acids, and in making further progress, they have developed a fixed micro-organism breeding technique where the microorganism itself proliferates even in a fixed state. Applying this technique, they have succeeded in developing a continuous manufacturing process for ethanol with a high yield, at a reaction rate 10-fold greater than the conventional process by fixing alcohol yeast.

For commercialization of Tanabe's technique, Kyowa Hakko and Godo Shusei have obtained the rights to use the technique and have also been working on it since last summer, but progress is slow. They had previously established a goal of 2 years, but now they expect to take at least another year. A P3 facility is mainly for basic research in gene splicing techniques at the moment.

Biotechnology Developmental State of Major Firms and Research Organizations

Corporate names	Substance of Development
Sankyo	Commercial distribution of enzyme SI, a nuclease required for recombinant DNA which was developed by the Institute of Physical and Chemical Research. Engaged in genetic engineering research.
Yamanouchi Pharma-ceuticals	Laboratory of cell physiology in the central research laboratory. Pharmaceuticals development using genetic engineering techniques in progress with 10-odd staff members.
Mochida Pharma-ceuticals	Stated the production of fibroblastoid cell interferon in the summer at the Shizuoka plant. Collaborative agreement with Ringen Biological Chemical Research Laboratory for commercialization of

	lymphoblastoid cell interferon by the hamster method. Commercialization of immunodiagnostic agents using cell fusion technique in 1-2 years.
Otsuka Pharmaceuticals	Collaborative agreement with Ringen Biological Chemical Research Laboratory for the commercialization of lymphoblastoid cell interferon by the hamster method. Research under way at Tokushima laboratory on the creation of physiologically active substances by cell fusion in cooperation with its subsidiary, Nippon Antibody Research Lab and others.
Tanabe Pharmaceuticals	Technical establishment of a continuous ethanol manufacturing process using fixed yeast breeding. Having P3 facility, basic research in recombinant DNA.
Fujisawa Pharmaceuticals	Basic research with P3 facility. Focus on improvement of manufacturing processes for antibiotics such as cost reduction and mass production, and the development of new drugs.
Shionogi & Co	Acquisition of basic techniques through close relationship with Lilly in the United States, which is engaged in clinical testing of insulin produced by recombinant DNA technique; emphasis on applied research in the field of antibiotics.
Sunstar	Installation of a testing plant for interferon produced by fibroblastoid cell culture (monthly production of 100 million units); in trial production.
Toyo Jozo	Basic research on manufacturing processes, etc of antibiotics using genetic manipulation techniques, plans to strengthen research structure for above work.
Meiji Milk Products	Basic research on interferon; also examining related research by genetic manipulation techniques.
Snow Brand Milk Products	Strengthen pharmaceuticals direction based on fermentation technique of Lactobacillus. Research underway on fixed enzymes.
Morinaga Milk Ind	Lactobacillus culture in high concentration by mass cell culture technique; commercialization of mass culture of useful anaerobics under aerobic conditions; basic research underway on bioreactor and genetic manipulation.
Morinaga Confectionery	Conducting research in the life science field and genetic structure in the biochemistry laboratory, but specific results are to be seen.
Oriental Yeast	Research underway on manufacturing techniques of fixed enzymes using a radiation polymerization process commissioned by Research Development Corporation of Japan.

Kagome	Research underway at the research laboratory for improvement of tomato crops, etc by cell fusion technique.
Yakuruto	Distributing fixed enzymes manufactured by Kinki Yakuruto; basic research underway on genetic manipulation and cell fusion of microorganisms such as Lactobacillus.
Sapporo Brewery	Research on enzymes and microorganisms at the central research laboratory and applied development laboratory. Research underway on carcinostatic selenium macromolecular substances in metal by microbiological application.
Ashi Breweries	Research underway at Ebiosu Yakuhin on carcinostatic action and hypotensive action of YCW, a cell wall component of brewers' yeast.
Kirin Brewery	Acquired a patent for interferon-inducer; appears to have begun research on cell fusion enzymes.
Suntory	Begun research on messenger RNA required for gene splcing; developed an energy-saving alcohol fermentation process which is applicable to manufacturing of fuel alcohol from biomass.
Godo Shusei	Bioreactor using fixed enzymes; research on alcohol fuel by joining the new Fuel Oil Development Technology Research Association
Takara Shuzo	Distributing 18 kinds of restriction enzymes, 1 kind of DNA ligase, and 2 kinds of substrates (DNA itself). Supplying governmental and private research organizations. P3 facility under construction to be completed this year.
Sanraku-Ocean	Research on biomass fuel by joining the new Fuel Oil Development Technology Association; also begun genetic manipulation research; distributing trial enzymes of the nuclease group; prepublication of patent for manufacturing bacteriophage.
Kokkoman	Having a bilateral research structure of Noda Sangyo laboratory and the central research laboratory, DNA work is mainly done at the Noda Sangyo laboratory. Developed a cell wall fusion enzyme, pectoliase [transliteration] Y23 and have begun exportation. Noda Sangyo laboratory has 3 cases of prepublished patents including a new recombinant DNA process.
Yamasa Soy Sauce	Established mass production technique for monoclonal antibodies by cell fusion technique, and moved onto applied research for diagnostics. Acquired patent to manufacture DNA.
Toyo Rayon	Research at the basic research laboratory on the mechanism of restriction enzymes; developing mass production techniques for pharmaceuticals such as interferon, antibiotics, etc by genetic manipulation.

Teijin	Began genetic engineering research at the basic research laboratory of the central research laboratory aiming at mass production of pharmaceuticals by genetic manipulation in the future.
Asahi Chemical	Began basic research in genetic engineering based on fermentation technology; future direction is mass production of drugs by genetic manipulation.
Toyobo Co.	Commercialization of fixed enzymes, glucose oxidase and uricase for diagnostic testing. Developing acyl CoA, cholesterol oxidase aiming at commercialization in 1982, expected to become diagnostic reagents for biomedical engineering.
Unitika	Bioreactor research; partly commissioned by the Institute of Physical and Chemical Research and the Research Development Corp of Japan, commercialization expected in 2-3 years. Prospect for completion of ATPase reproduction technique for energy source ATP; research underway for upgrading systems scale.
Kanegafuchi Chemical	P3 facility being completed. Immediate focus is recombinant DNA technique in the field of antibiotics.
Showa Denko	Gearing up for process improvement with recombinant DNA for amino acids (for feeds) such as tryptophan prepared by a synthesis process and a semisynthesis process using Bacillus subtilis. Work for mass production of active substances such as hormones, vitamins, enzymes, etc and develop into pharmaceutical field.
Denki Kagaku	Developed a fixed enzyme for isomerized sugar together with Nagase Sangyo; had the production aspect with Nagase having the distribution aspect. Research on immunology at the subsidiary, Toshiba Kagaku (sales make-up: 50 percent vaccine, remainder, diagnostics). Both Denki Kagaku and Toshiba Kagaku have P2 facility.
Mitsubishi Petrochemical	Developed thermostable enzymes and contributed greatly to enzyme utilization. Developed a screening technique for metabolic regulators. Engaged in technical development of bacterial cell culture and improvement with subsidiary, Mitsubishi Yuka Yakuhin.
Mitsui Toatsu Chemicals	Development of mainly amino acid-related substances based on SCP (microbial [single-cell] protein) technique. Expansion of facility by fall at either the central laboratory or biological science laboratory. Subsidiary Mitsui Seiyaku plans to install P3 facility by 1982.
Mitsubishi Gasu Kagaku	Aim to unite C_1 chemistry and genetic engineering using methanol. Research on methanol bacteria.
Sumitomo Chemical	Supplying the research team at the Ministry of Health and Welfare with imported interferon from the lymphoblastoid technique for

	clinical use. Aim for domestic production at the minimum monthly rate of 40 billion units before the year-end. Developed low-temperature fusion technique for plant cells. All-out effort to be gathered for bioreactor development.
Kansai Paint	Lead in the technology to fix enzymes on a photohardening resign with ultraviolet ray based on an import technology. Joined technical research association and engaged in the joint development of automobile alcohol fuel.
Dai Nippon Ink	Developing primary pharmaceutical substances, chemical products by genetic means at (Foundation) Kawamura Physical Chemical Research Laboratory and biochemistry division.
Nagase Sangyo	Subsidiary, Nagase biochemistry produced a fixed enzyme for isomerized sugar. Possess a fixed enzyme technology.
Ringen Biol Chem Res Lab	Interferon production facility of the largest scale in the world (300 billion units/year); produced by lymphoblastoid cell technology using hamsters. Research on mass-production of physiologically active substances and useful hormones produced by lymphocytes applying the cell growth technique of the hamster method. Plan to supply interferon to the Pasteur Inst in France, Mochida Seiyaku, and Otsuka Seiyaku.
Sagami Cent Res Lab	Developed a new reaction system which can produce in high yield substances of high added values such as pharmaceuticals and flavors by using microorganisms.
Inst Phy Chem Res	Construction of the first Japanese P4 research facility at Tsukuba Campus city with a 2-year plan. Began microorganism strain maintenance work in April. Has 4 cases of prepublication patents as of the end of 1980 for manufacturing process of nuclease, etc.
Nat Inst of Health	Developed a recombinant host-vector system for recombinant DNA using actinomycetes that can produce antibiotics.
Fermentation Research Institute	Research on the relationship of the bacterial ability to decompose mercuric compounds, PCB, etc and the plasmid.

(note) See text for Green Cross, Takeda Chemical, Kyowa Hakko, Meiji Seika, Mitsubishi Chemical, and Ajinomoto. University-affiliation excluded.

Interview [insert from pp 110-111]

Rush Without a Set Goal

[Itaru Watanabe, Professor, Keio University School of Medicine]

[Text] [Question]--We have genetic engineering fever these days. What are your views on the genetic engineering development structures of private sectors, government, and the recently mobilized civil-government joint venture?

Watanabe: Including industry, all are in a confused state with speculative ideas. There is no awareness of why genetic engineering is necessary or an autonomic structure is necessary. In that respect, Euro-American concerns have a much clearer concept. Although it is the wrong intention, their concept is indeed "Beat Japan."

In December of last year, an expert meeting in genetic engineering was held at OECD, to which I was invited and attended. OECD decided to promote genetic engineering and prepared a draft to call on various countries, in order to hear their opinions. Japan stands advantageously in the world with a fermentation industry, microbiology industry, as well as an enzyme industry. These industries were once Europe's favorite industries, but are now on the decline. Therefore, to recover lost ground, they are trying not to let Japan take the lion's share in genetic engineering.

The United States, at present, is far ahead in recombinant DNA as a star in genetic engineering. Thus, the United States is confident. However, due to automobile industry problems and others, they are siding with Europe in genetic engineering.

In Euro-American countries, recombinant DNA technology is emphasized and efforts are being made to raise it to a national level. Moreover, the effort is to raise it to the level even beyond nations such as the EC.... There has been no such effort in Japan. Individual firms become feverish in genetic engineering independently and send many people to the American business firms in this venture. They are only trying to take the lion's share by going to the United States.

With such an attitude, technological innovations cannot be accomplished. The important thing is to consider seriously how to set up an autonomic structure in genetic engineering within the country. In order to do that, a clear goal must be set in genetic engineering. That goal must be established by further dividing it into interim and long-term goals. Such goal-setting is not being done in Japan.

[Question] The recent genetic fever is said to resemble the post-World War II competition for manufacturing penicillin....

[Answer] May I state the conclusion first, it does not resemble the penicillin competition. At that time, the goal was clearly to manufacture antibiotics represented by penicillin. At present, they are lost in labels, genetic engineering, recombinant DNA, etc, and there is no clear goal of what to do, what to produce.

[Question] By using genetic engineering, how do you think the future industry will change?

[Answer] At the OECD meeting, I said that the chemical industry and microbiological industry will be united in the future. Production by recombinant DNA techniques and ordinary chemical techniques become one, making a new production technology. I think the so-called biological methods and chemical methods will be combined to develop into a unified direction to produce substances. When that happens, I sense that with respect to capital and personnel force, the fermentation industry will be incorporated into the chemical industry with recombinant DNA technology as the nucleus.

Currently, pharmaceuticals and precious drugs such as interferon are the goals. However, as it identifies with the general chemical industry, it will probably change from such a high-value, low-volume industry to a low-value, high-volume industry. As the next step from pharmaceuticals, it will be applied to amino acid fermentation or antibiotics.

[Question] I hear that the first international symposium of the Asian Molecular Biology Organization (AMBO) is to be held in Tokyo in December of this year....

[Answer] AMBO was born out of the concept of the European Molecular Biology Organization (EMBO). EMBO was initially a private organization funded by the Volkswagen Foundation. Now, various European governments are funding the organization which has eveloped into an international organ for developing free research.

The idea for AMBO is to make it a base for the development of molecular biology in Asia. It is an organization without national units, but for Asian as well as Euro-American researchers worldwide. It is, in other words, an organization for "individuals" in the world for Asia. In fact, when nations are involved, things become complicated.

AMBO was established in April of last year with appeals from Dr James D. Watson, of the United States, a 1962 Nobel laureate for physiology and medicine, and Shiro Akahori, former president of the Osaka University. For the time being, funds are sought in private sectors such as business and financial circles without relying on governments. So, I am doing my legwork here and there for the office of the organization. It is a significant organization for Japanese molecular biology to stand as an international entity. I would like to make the symposium a success as an international entity. I would like to make the symposium a success in December.

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SCIENCE AND TECHNOLOGY

ROBOT PRODUCTION UP 85 PERCENT

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 960, 23 Jun 81 p 7

[Text] Production of industrial robots in 1980 swelled by 85 per cent over a year earlier to ¥78,400 million, according to a checkup by the Japan Industrial Robot Association having 35 robot builders as its members.

In terms of number, the year's output stood at 19,000 units, up 35 per cent from the preceding year.

An association spokesman noted that production of more sophisticated, microcomputer built-in robots increased last year, with the result that the annual growth of production value was far sharper than that for unit production.

It appears, the spokesman added, that the robot industry will emerge as a ¥100 billion business at the end of this year, now that various industrial sectors are eager to install more robots at their plants in an effort to attain all-out automation and more manpower saving.

By type, production of assembly robots in 1980 increased by 340 per cent over a year earlier in terms of value (or up 33 per cent in terms of number), that of arc welding robots, by 211 per cent (or up 200 per cent), that of painting robots, by 88 per cent (or up 100 per cent), spot welding robots, by 85 per cent (or up 100 per cent), and that of press processing robots, by 60 per cent (or up 6 per cent).

By user sector, electrical machinery builders proved the best customer for the industry in 1980, with their share in total shipments accounting for 36 per cent (against the 18 per cent a year earlier). Automobile manufacturers lost their position as the No. 1 robot purchaser, ranking second with 30 per cent (against 38 per cent a year earlier).

Deliveries to non-ferrous metals smelters and metals processing sectors moved appreciably higher.

Partly behind the rising robot demand is an acute shortage of skilled workers engaged in the welding, painting and pressing fields. A survey by the Ministry of Labor shows that the shortage of skilled workers last year increased by more than 200,000 over 1979 to 836,000.

Noteworthy in the recent robot demand trends is the fact that small- and medium-sized enterprises, which are suffering from an acute lack of technical experts, are employing more robots at their factories for arc welding and painting purposes.

Major automakers, anxious to attain more quality control and to produce an increasing variety of vehicles, are and will remain a big robot user.

Demand for industrial robots is expected to grow at an annual rate of around 50 per cent, and in 1985 the industry may become a ¥500 billion business.

Computer Exports By 6 Major Makers

(In billions of yen)

	FY1981 (planned)	FY1980
Fujitsu	40	37
Hitachi	28.5	20
NEC	21	15
Toshiba	8	4.6
Oki	7	5.8
Mitsubishi	7	5

Note: Figures for fiscal 1981 exclude new machines to be shipped abroad. Actural export figures thus will be far larger.

customers are less costly than those for large computer customers.

Moreover, they have the advantage of utilizing their existing marketing routes for facsimile machines and copying machines when they try to boost sales of personal computers, printers, word processors and other office automation (OA) equipment in overseas markets.

Nippon Electric Co. (NEC) also is very aggressive toward exports as it established in January a special section for promoting exports. NEC plans to start exporting the new office computer it unveiled in April from the second half of fiscal 1981 mainly to the U.S., Southeast Asia and Australia. Also, it has been shipping its PC-8001 personal computers to the U.S. since March. During the three-month period until May, NEC exported 5,000 units of PC-8001s to the U.S.

Toshiba Corp. will start exporting personal computers and word processors to Europe. It will make the most of its copying machine marketing network for their sales.

Oki Electric Industry Co. and Mitsubishi Electric Corp. plan to boost exports of printers and office computers.

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SCIENCE AND TECHNOLOGY

PROGRESS IN ROBOT INDUSTRY EXPORT SITUATION ANALYZED

Tokyo NIHON KOGYO SHIMBUN in Japanese 11, 13, 15 May 81

[11 May 81 p 9]

[Text] Japan's reputation as an advanced robot country is now well established throughout the world. The robot industry has just started to engage in export business, aiming at selling products to European nations and the United States, armed with a stock of software know-how and a sophisticated production technology. Currently each company is actively involved in developing marketing routes, for example, trying to promote specialized systems such as reexporting to counterparts in technical tie-ups, and to set up sales agents. The robot industry dubbed last year as the "Initial Year for the Dissemination of Robots," and devoted itself to popularization and promotion to obtain some tangible results. In this respect, this year may be regarded as the "Initial Year for Robot Export."

(Reporter: Norio Konuma)

The recent giant step taken by the robot industry is something more than an object of admiration. When viewing only the actual production, it is not so impressive: 60 billion yen (partially estimated)/year in FY 80. However, it has news value and is reported almost every day in the newspapers because of the emergence of new makers one after another, the rapid tempo of the product development and promising marketability, etc.

For your information, some of the new makers that have recently entered this industry: Matsushita Electric Industry, Mitsubishi Electric Corporation and Osaka Transformer have started to make robots for arc welding, while Nitto Seiko, Sankyo Seiki Manufacturing Co, Pentel, Okamura Manufacturing and many more have entered the field of manufacturing robots for assembly, fitting and transportation.

The existing makers have also commenced the development of products in fields new to them; for instance, Mitsubishi Heavy Industries is interested in robots for arc welding, Yasukawa Electric Manufacturing in small robots for arc welding, Fujikoshi in totally automated robots for spot welding, Fujitsu Fanuc in robots for assembly and Kawasaki Heavy Industries in robots for painting and arc welding. All of these new and old participants are vigorously competing with one another for markets.

Likewise, although the production in yen is still insignificant—an estimated 60 billion yen in 1980--the growth rate of the industry showed a 26.4-percent increase in FY 78 against the previous year, a 55.3-percent increase in FY 79 and a 41.5-percent increase in FY 80, showing a surge during the past few years. The forecast for the future predicts a production of 290 billion yen in FY 85, which is almost a 500-percent increase in 5 years from 1980. It is certainly not an overstatement that this industry is expected to have the fastest growth in the machine industry.

The robot industry, which has shown continuous growth at such a pace, reported, however, an unbelievably low export ratio in 1980, "probably in the area of 2 percent." (Japan Industrial Society for Industrial Robots) This slow start in exports may be attributable in some part to the attitude of the industry which was fully occupied with product development and concentrated its efforts on domestic popularization, but more importantly, to the delay in implementing an export system, caused by: 1) difficulty encountered in exports due to territorial disputes because of the nature of the industry that was initiated by technical tie-ups with overseas manufacturers; 2) delay in establishing overseas marketing routes.

Now, at this turning point, the strategy of each company has switched over to a positive export policy, which is manifested by facilitation of exports by an easing of territorial disputes with the counterparts of the technical tie-ups and by the opening of routes through the establishment of overseas sales networks. This reflects not only the industry's confidence in the finished product but also the results of the industry's all-out effort to promote exports based upon recognition that it can offer a promising future export commodity, as exemplified by the statement: "Robots are a strategic commodity that will be the support and driving force of the next generation." (Yoshio Ando, president of Japan Industry Society for Industrial Robots)

In fact, each company began taking action at an accelerated rate starting in the latter half of last year: two corporations, Kawasaki Heavy Industries and Kobe Steel, have promoted international specialization including reexport of products in part with counterparts in technical tie-ups, Unimation of the United States (Kawasaki) and (Tralfa) of Norway (Kobe Steel), and Yasukawa Electric Manufacturing has one after another forged sales tie-ups with European and American welding machine makers. Fujikoshi will establish agents in the United States following the precedence in Europe before the end of this year, and Mitsubishi Heavy Industries and Taiyo Tekko both will establish an agent network in Europe and America. Hitachi Ltd has started OEM export (product production in the plants of the counterparts) to Automatics of America.

This new trend is backed up by an increasing interest overseas in superior Japanese-made robots, but it is of course largely attributable to the robot maker's policy which made a 180-degree turn from the past defensive posture to positive involvement in export promotion.

Speaking of robot exports, last year Kawasaki Heavy Industries received a large order for 26 units of robots for welding from the USSR. There were no other remarkable activities reported except that Yasukawa Electric Manufacturing and Fujikoshi both had a constant flow of exports to Europe through their tie-up counterparts. Starting this year, however, robot exports will be greatly increased.

[13 May 81 p 8]

[Text] Reviewing the history of robots in Japan, production of robots for welding and robots for painting was commenced by Kawasaki Heavy Industries using technology imported from Unimation of America and by Kobe Steel using technology imported from (Tralfa) of Norway respectively. With these two products as a backbone, numerous makers have developed their own robots. This is one of the factors that have delayed the export of robots.

Although Japan resorted to overseas makers for the basic technology mentioned above, Japanese robt makers are now ahead of the overseas makers which are counterparts in the tie-ups, because Japan positively introduced robots due to the commanding interest in robots, particularly in the software know-how field such as utilization technology, by users headed by the automobile industry, and because makers have been actively involved in developing control technology and product improvement in a sense to accommodate the user's expectations. The reversal is shown in the language used by both companies: "We are better in manufacturing and moving robots" (Kawasaki Heavy Industries); "We are more advanced in the area of robot control" (Kobe Steel). This unquestionable fact leads to the reexport of these products in the form of promotion of international specialization with the counterparts in the tie-ups.

Citing an actual example of this trend, Kawasaki Heavy Industries completed an agreement to supply the "Unimate 6060 model," a large robot expected to have the highest demand among robots for spot welding, to Unimation of America. Also, it is working on a system to produce and supply oil pressure products such as the servo-valves used in robots. This is because Kawasaki Heavy Industries can manufacture high-precision products that are low in cost. Cases such as this are expected to increase in the days ahead.

Meanwhile, Kobe Steel has also made some international specialization agreements with (Tralfa) to enter the export business: 1) Kobe Steel imports high class robots with flexible arms from (Tralfa) and reexports and supplies standard models; 2) all control systems will be supplied by Kobe. It is planning an aggressive marketing campaign in the communist bloc outside the normal territory.

Next, referring to Yasukawa Electric Manufacturing and Fujikoshi, which have already been engaging in a steady export business, Yasukawa has sales tie-up contracts with machine makers mainly manufacturing welding machines such as Hobart Brothers of the United States, Tors Teknik of Sweden, Messer Griesheim of West Germany, GKN Lincoln of England and (Arcos) of Italy. It exported about 50 robots for arc welding last year, and intends to double that amount to 100 units this year.

Fujikoshi has signed a sales tie-up contract with (Kuka) a West German welding machine maker, and exports several arc welding robots every month to Europe. It is already in the process of finalizing the selection of candidates as it plans to conclude sales tie-up negotiations with an American welding machine maker and to export robots to the United States before the end of this year.

Likewise, Hitachi Ltd has offered the technology for process robots to Automatics of America and has started OEM export of these robots. Also, it is thinking of a positive export plan--an expansion of exports by sales tie-ups with several European and American machine makers.

Mitsubishi Heavy Industries, which has not exported robots in the past, is planning to conclude an agent contract with some machine makers, especially painting machine makers in Europe and America, to ride the wave of robot exports on a full scale. It is also investigating the feasibility of offering technology overseas and is setting the high goal of claiming 30 percent of robot sales by exports in the future.

Other activities aimed at forging an export structure are exemplified by: an all-out offensive for exports by Taiyo Tekko starting this fiscal year by establishing agents in three selected areas--the Soviet Union, America and Europe--and particularly in Europe by establishing agents in four countries--West Germany, England, France and Sweden--after selecting (Sarpart) of Belgium as an agent; Shinmeiwa Industry's tie-up with COMERCIE of France and Aga of Sweden; and Toshiba Seiki's sales tie-up with the Swedish motor manufacturer STM.

Additionally, Fujitsu Fanuc, which has actual extensive export experience with the NC (numerical control) system, is trying to export robots through the same route and appears to be very confident: "We sense enthusiastic responses."

Whatever it may be, as explained before, each robot maker has been stressing the consolidation of their export systems from last year to this year, and some makers have already achieved considerable export results. It is only a matter of time, seemingly, for robot exports to get on the right track.

[15 May 81 p 9]

[Text] "Considering the robot population density by units, Japan has a higher number than America and Europe together. It also has an accumulation of know-how and ranks at the top in competitive power," boast the Japanese robot makers in chorus.

Well, have robots really spread so much in Japan? How many robots are used in every country in the world? It is very difficult to get accurate figures. Although they may be slightly outdated, let us look at the statistics compiled by the American Robot Association in March 1979. These figures were compiled at a meeting held in Washington for robot-related industry from all over the world, and were described as "the most reliable statistical data of their kind." (Japan Industrial Society of Industrial Robots)

According to the data, the total robot population by units is overwhelmingly high in Japan, which claims 47,000 units, followed by 5,850 units in West Germany, and then by 3,255 units in the United States. Other countries show extremely low figures; for instance, 720 in Poland, 570 in Sweden, 200 in Norway, 185 in England, 130 in Finland and 20 in Belgium. Next, singling out from the rest the high class robots which include playback mechanisms, Japan has 3,000 units, the United States 2,550, Sweden 570, West Germany 150, England 145, and Poland 110. As far as can be seen from these statistics, Japan certainly is way ahead in robot production by units, and the robot industry's indulgence in bragging is understandable.

Behind the rapid spread of robots in Japan are the rationalization of industries, the strong will and desire for energy conservation and the stringent demands on the makers from the users. A typical example of the former is the mass introduction of robots into the automobile industry which exhibits the greatest interest in the upgrading of production efficiency by rationalization. An example of the latter is the strong demand from the major manufacturers headed by the automobile industry upon the smaller subcontractors urging introduction of robots. The delicate evolution of these factors, intensifying the competition among the industries, is linked to the propagation of the robots.

Now, do they encounter these factors and the demand from the makers for introduction of robots in European nations and America? As you know, it has been predicted that the American automobile industry will show a more positive attitude toward the introduction of robots in the future in order to compete successfully against the Japanese makers. The largest, General Motors (GM), for instance, is planning to introduce an army of robots, calling for 14,000 units in the 1980's, which shows a new tendency to regard the introduction of robots as the decisive factor in increasing productivity. The spread of robots in Japan also owes its start in part to the mass introduction of robots in the automobile industry. Similarly, in America, a move for switching over to robots will not only sweep the automobile industry but will also extend to other industries.

What is more interesting is the fact that the American automobile industry is fascinated by Japanese robots. In fact, two major companies, GM and Ford, have made inquiries of Kawasaki Heavy Industries regarding a total of over 100 robots for spot welding. Between Kawasaki Heavy Industries and Unimation of America, agreement has already been reached for Kawasaki Heavy Industries to be solely responsible for production of a large robot, the "Unimate 6060 model." This deal was made possible through the mediation of Unimation of America. However, it appears that GM and Ford are set on "getting robots made by Kawasaki Heavy Industries as much as possible," without limiting the deal only to the 6060 model.

They are apparently attracted by the fact that Kawasaki's robots are used in large numbers in the Japanese automobile industry and are noted for their excellent reliability. Such a deal is not exclusive to Kawasaki Heavy Industries. Kobe Steel, which has a technical tie-up with (Tralfa) of Norway and has had excellent results in production of robots for painting, says: "America is the territory of (Tralfa), but American automobile makers have sent inquiries directly to us expressing a wish to purchase Japanese-made robots," and it is even interested in exporting robots to the United States since the easing of territorial issues.

Also, aside from only the large corporations like those of the automobile industry, smaller overseas makers are more enthusiastic about the Japanese robots than the large corporations. "One of the reasons for the NC machine tool export increase was the unshakable popularity of the product among the smaller makers. The same analysis can be concluded for robots." (Fujitsu Fanuc) Yasukawa Electric Manufacturing's robots for arc welding, which continue to be exported steadily, seem to be well accepted in this part of the business world. Judging from this, European nations and America are starting to accept robots and are expected to offer promising markets.

At any rate, European nations and America have concluded that the introduction of robots into industries were necessary for them to win the international competition against Japan. Ironically, however, that acknowledges plainly that the Japanese robots are proven to be the best. In the past, Japan worked hard to catch up and outdo the advanced European nations and America in textiles, steel and iron and automobiles, but the robot industry indicates a totally reversed picture. It will not be long before masses of Japanese-made robots are working in the lands beyond the seas.

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SCIENCE AND TECHNOLOGY

1980'S DUBBED '2ND INFORMATION REVOLUTION ERA'

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 960, 23 Jun 81 p 1

[Text] The Industrial Structure Council, advisory body to the international trade & industry minister, feels that the 1980s will become the "Second Information Revolution Era."

It aired such a view in its recommendation on the "direction of the information industry in the 1980s." The report itself was drafted by its committee on information industry.

After pinpointing the 1980s as being a "second revolution," the council emphasized the necessity to take the following steps at an early date:

—Abolish restrictions on use of leased circuits for information communication, and completely review the leasing system, including setting of fees.

—Set up an overall research-development machinery for promoting technological development.

—Develop information systems for medicine, education, living and other areas close to the people and popularize them.

It also considered it was essential for the Government to offer funds to consolidate the foundation of such an information society.

Specifically, the council took up the matter of improving the system on use of leased lines for communication.

It noted that the present law on public communications services stringently controlled "joint use" of circuits among companies, and "third party use," that is, communication between an enterprise and its data service customers.

The recommendation sought virtual abolishment of such regulation, and freeing use of circuits in principle.

The council also felt that the present leased circuit fee system of charging less for places nearby and higher for distant places, as used for telephones, should be changed since this would obstruct the beneficial effects of on-line services to distant places.

It advocated drafting a new fee system in place of the present one.

As to technology development which holds the key to future progress of an information society, the council cited the immediate importance of the following phases: 1) software having wide usability; 2) high-speed computation system for scientific purposes; 3) fifth generation computer having an extremely high capacity.

As to basic technologies anticipating the future, it mentioned the need to swiften development of optical communications, sensors, intelligent robots, and automatic translation system.

It foresaw the necessity of an overall machinery, comprising the government, academia and industry, for developing such aspects since each would require gigantic investments.

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SCIENCE AND TECHNOLOGY

COMPUTER EXPORT BY SIX MAKERS TO TOP ¥100 BILLION

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 960, 23 Jun 81 p 8

[Text] Computer exports by Japan's six largest computer builders will far exceed ¥100 billion in fiscal 1981. They shipped about ¥87 billion worth of computers in fiscal 1980.

On the strength of the high reliability of their machines, Japanese computer makers will make a frontal challenge against International Business Machines Corp., Burroughs Corp., Sperry-Univac and other American makers in the world market.

Shipment of Japanese-made computers to markets overseas has been rising at a fast pace since the beginning of fiscal 1981. Foreign orders are not limited to large-scale models. Small-scale machines, personal computers and terminals also have been strongly sought.

Top maker Fujitsu Limited has been boosting exports, centering on large machines. In fiscal 1980, it sold abroad around ¥37 billion worth of computers mainly through Amdahl Corp. of the U.S. and Siemens AG of West Germany on an original equipment manufacturer (OEM) basis. This year, Fujitsu is to start marketing medium- and small-scale computers in the U.S. through TRW-Fujitsu Co., a joint venture it set up last year with TRW Inc. of the U.S. With the new marketing channel, Fujitsu's computer sales in overseas markets will top ¥40 billion this year, Executive Director Yuichiro Koide said.

Hitachi, Ltd. has been swamped with orders from abroad. During the recent several months, it received foreign orders for an average of 10 large-scale machines a month. They include those for the M-280H very large-scale machine that Hitachi unveiled in February. Major foreign inquirers include National Advanced Systems Inc. of the U.S., Olivetti S.p.A. of Italy and BASF AG of West Germany. Hitachi has revised its export program for the current fiscal year to cope with the new situation.

High efficiency and reliability attract foreign customers, say executives of Fujitsu and Hitachi.

At present, IBM controls 60 per cent of the world's general-purpose computer market. Burroughs, Sperry-Univac and other American computer builders follow IBM. Among makers of IBM-compatible computers, Fujitsu and Hitachi ranks first and second in the world. If they succeed in establishing firm footholds in overseas markets, Fujitsu and Hitachi will become leaders of IBM challengers, industrymen observe.

Markets for small-scale computers, office computers, personal computers and terminal equipment have been expanding at a far faster tempo than that for general-purpose computers. Japanese makers of these products can easily boost exports because software and maintenance services to

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SCIENCE AND TECHNOLOGY

NTT MAKES SWIFT, SUPER PRECISION ELECTRON BEAM EXPOSURE SYSTEM

Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 960, 23 Jun 81 p 17

[Text] Nippon Telegraph and Telephone Public Corp. (NTT) has announced development of a new super-precision electronic circuitry drawing electron beam exposure device.

It is said to be capable of producing a circuitry element of 0.5 microns in line width at a speed of only 1/10th of the fastest so far known.

NTT's new device is named EB55. It was created at its Musashino Electrical Communication Laboratory in Tokyo and intended for producing submicron circuit elements with capacities of between 1 megabit and 4 megabits on a substrate a few millimeters square in size. Above the submicron level, LSI (large-scale integration) types of such circuit attaining 3 microns in line width and 64 kilobits in memory capacity are already being commercialized. More sophisticated 1-micron line width, 156-kilobit capacity types are also being produced commercially on trial basis.

Various similar submicron circuit electron beam exposure systems have already been developed as trial devices in Japan or elsewhere.

But all have fallen short of being commercialized because even on a 10-centimeter square substrate, it has taken 10 hours or even longer to do each round of drawing job.

NTT's EB55 system has solved such a time-consuming problem by making it easy freely to change the cross-section picture of the beam and introducing a special Vector Scanning System to restrict the beam exposure to only where it is really needed.

Moreover, its beam accelerating voltage is set at 30 kilovolts, 1.5 times the best known equivalent, and its pattern drawing precision was brought to only 0.1 micron in error range.

NTT believes its new achievement has at least opened the way for a decided advance in Japan's VLSI developing technology though it still needs various accompanying new processes, including that of producing oxidized filming of the circuits.

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SCIENCE AND TECHNOLOGY

BRIEFS

NUMERICAL CONTROL DEVICE--Numerical control device to run machine tools without preparatory programming or computer language has been developed in Japan by Okuma Machinery Works, Ltd. of Nagoya, the company recently announced. The new NC device, which was immediately put on sale by the leading Japanese machine tool maker, follows the first of its kind to be developed in Japan, announced only last May 26 by Yamazaki Machinery Works, Ltd. of Oguchi Machi, Niwa Gun, Aichi Prefecture. Produced in many language versions, the first one is offered as a device operable even by an unskilled worker. It asks in Japanese, English or other tongues for instructions on its display screen and commands machine tools to perform the jobs according to the worker's responses which are given by pressing appropriate keys. The device is thus operable by anybody after a day or two's training. According to Okuma Machinery Works, its new product is a sophisticated version of its OSP3000 NC device for its mainstay machine tools. It is easy to operate for any worker who can operate universal lathes because it also seeks job instructions in the original language (Japanese) enabling the worker to answer each question and set the working program on the spot, job by job. [Text] [Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 960, 23 Jun 81 p 6] [COPYRIGHT: 1981, The Nihon Keizai Shimbun, Inc.]

POWERFUL LASER MICROSCOPE--A new laser beam-illuminated microscope with far greater resolution than conventional electric or sunlit types, has been developed by the Electrotechnical Laboratory, Agency of Industrial Science and Technology, Ministry of International Trade & Industry. According to the laboratory at Tsukuba, northeast of Tokyo, the laser microscope was developed by its research team led by Daisuke Kato, chief electron researcher, under the laser-utilizing cancer diagnosis and therapeutics research project subsidized by the Science & Technology Agency. Though its beams are guided onto the object specimen through an optical fiber line, the laser microscope works on the same principles as conventional optical microscopes. But the monochromatic (single color) and highly brilliant characters of the laser beams make a great difference in imaging any part of the specimen in contrast with others of conventional microscopes. With Tsukuba University's cooperation, Researcher Kato has succeded in photographic imaging, with the new microscope, of animal stomach and intestinal tissue specimens in precancerous conditions down to close intra-cellular details beyond the resolving capacities of the conventional microscopes. He has envisioned extensive applicability of the new microscope to industrial and other areas than the medical and biological field. [Text] [Tokyo JAPAN ECONOMIC JOURNAL in English Vol 19, No 960, 23 Jun 81 p 17] [COPYRIGHT: 1981, The Nihon Keizai Shimbun, Inc.]

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